RADIO and ELECTRICAL Review

TELEVISION - COMMUNICATIONS - SERVICE - SOUND

Incorporating "RADIO and ELECTRONICS"

DECEMBER 1st, 1956 VOL. 11, NO. 10

PRICE 1/10

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Radio and Electrical Review

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Official Journal of
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The New Zealand Radio and Television Manufacturers' Federation.
The New Zealand Radio and Electrical Traders' Federation.
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Sole New Zealand Distributors: Gordon & Gotch (N.Z.) Ltd., Wellington

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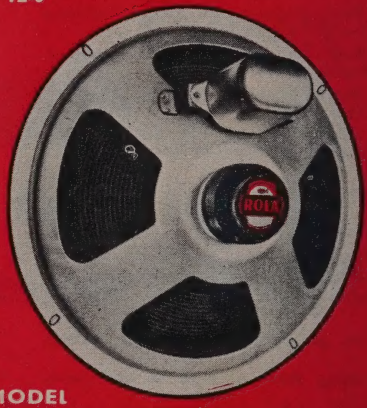

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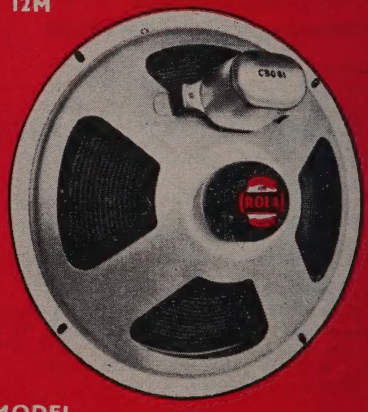

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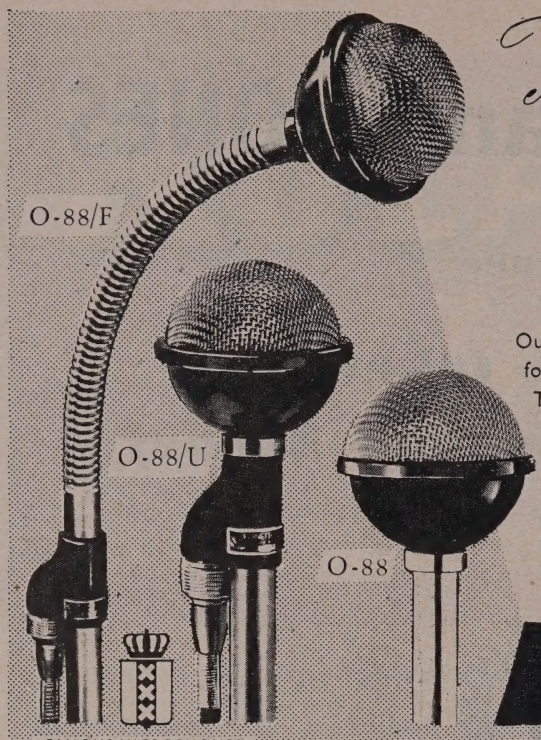

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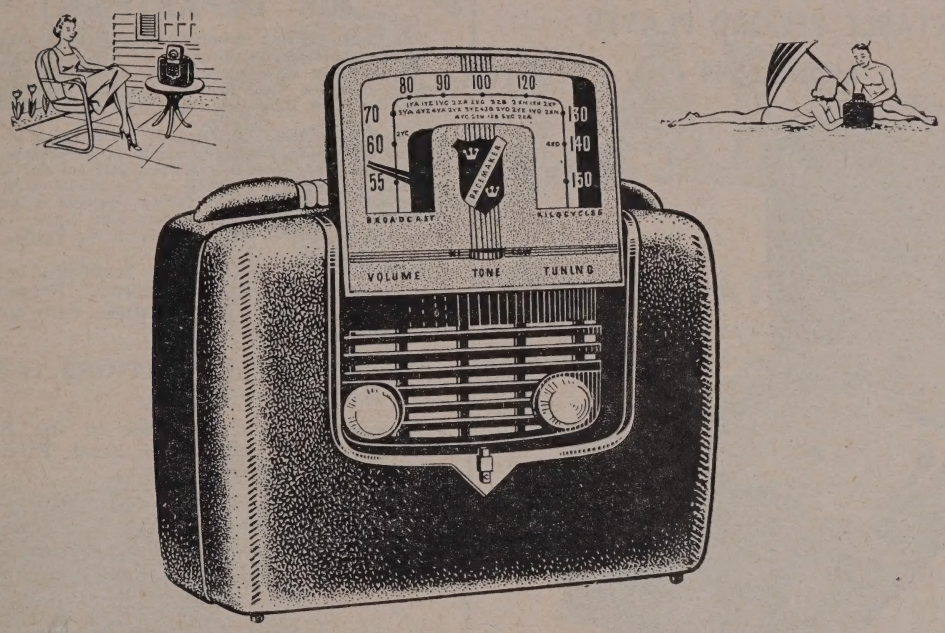

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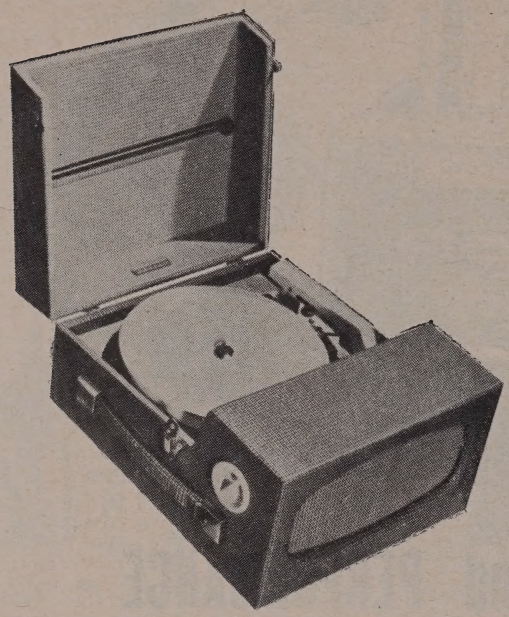

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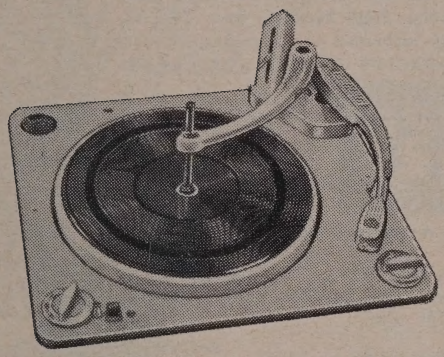

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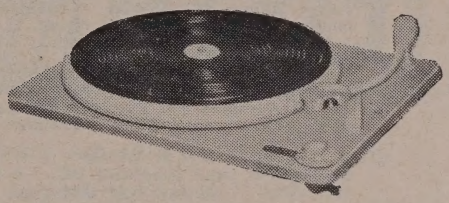

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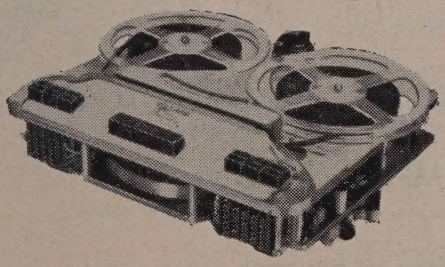

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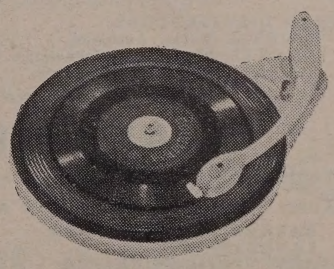

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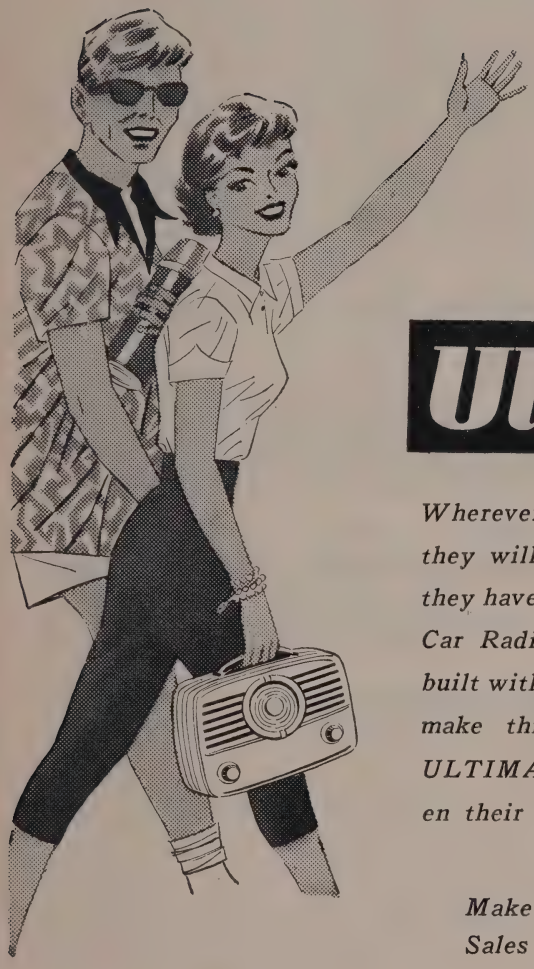

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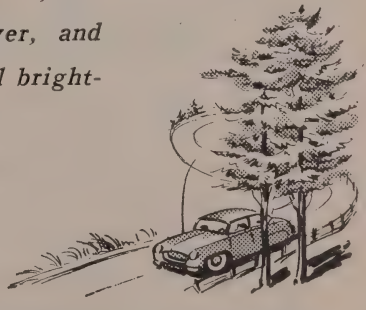

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			X	Y	
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E4205·B·7	70	600-1500	$\frac{170}{V_{a3}}$	$\frac{170}{V_{a3}}$	B12B
E4412·B·9	90	600-4000	$\frac{350}{V_{a3}}$	$\frac{750}{V_{a3}}$	B12D
E4504·B·16	160	600-5000	$\frac{600}{V_{a3}}$	$\frac{1100}{V_{a3}}$	B12D

Special screens are available to order.

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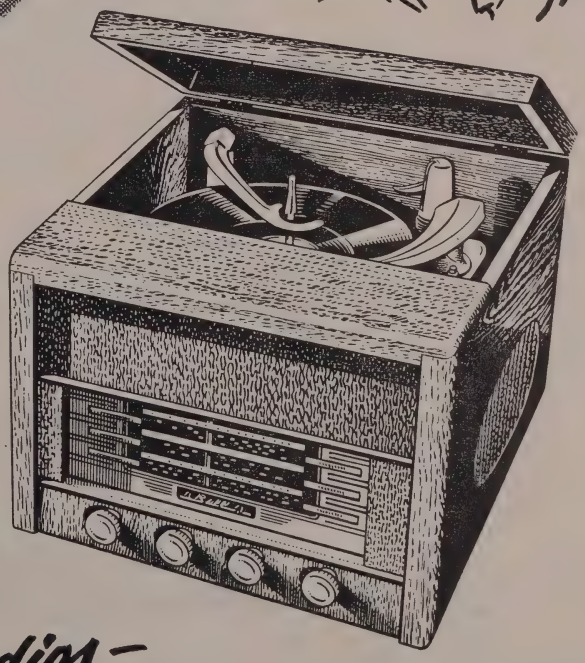

Features include a 5 valve radio, Monarch 3 speed automatic mixer changer and twin speakers. Cabinets in blonde or dark oak.

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Key 100

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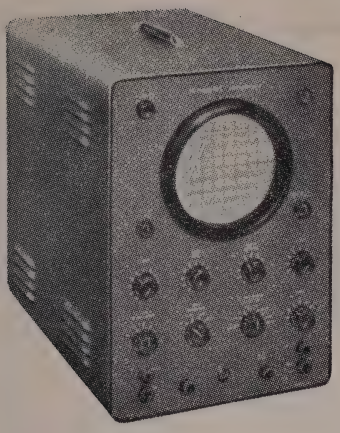

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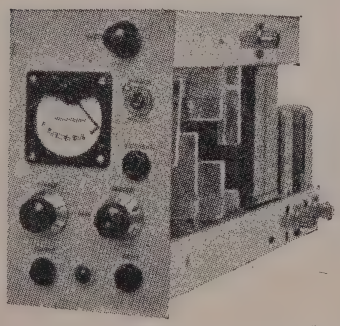

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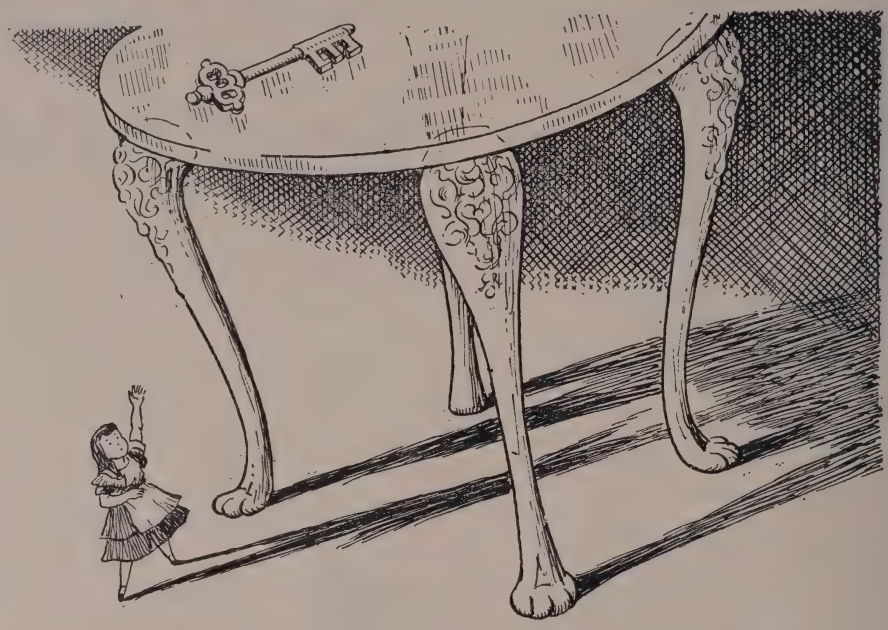
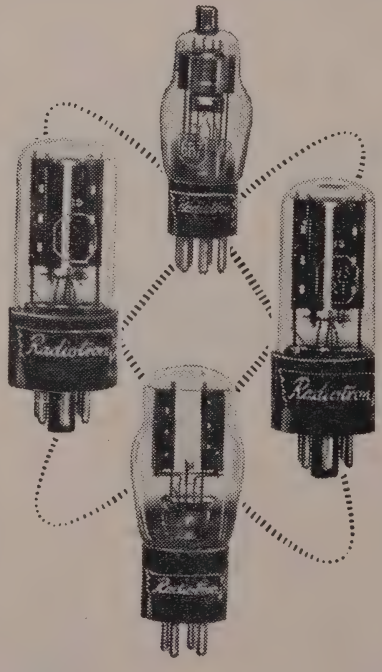


Alice knew what she wanted . . .



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A10

Greetings for Christmas and the New Year

A CHRISTMAS MESSAGE FROM THE PRESIDENT OF THE NEW ZEALAND RADIO AND ELECTRICAL TRADERS' FEDERATION

I wish you well. I wish you more luck and less need of it. What is luck? Good fortune? Yes, but you can make your fortune. How? By labour, thought, and fair dealing, looking forward and always forward. You can make it by the pursuit of better ideas and modern developments, and by having that sense of humour which makes a disaster a joke and triumph a funny story. I remember a man whose left leg was almost blown off; trying to mend him up I got his foot the wrong way round. However, having adjusted this small matter, he did well, and after his discharge from hospital, in conversation, I told him of my rather misdirected efforts. He roared with laughter, and said, "It's a good job you found it out, Sir, or I wouldn't have known which way I was going now!" So, don't get one foot going the other way; keep moving forward, for there's a visible horizon that way, which you haven't reached yet nor seen beyond. Behind you lie your victories and your mistakes, which make up your experience. Never forget either, they are a valuable asset—on that horizon appear new victories, new mistakes, new experiences.

Television! It is still indistinct, but identifiable, and should be approached with caution. Is it coloured? Is it clear? Is it under control? Steer fine towards it, but with the utmost vigilance. Reduce speed of approach, but keep a steady, careful course towards this great object. It will never affect our steady progress in the advance of radio dissemination and communication, but, handled with care and confidence, can sail in convoy—a proud addition to our fleet. Let us then go forward on our voyage, in station one with the other, keeping our course and speed together towards greater prosperity and the advance of our science and trade. Make your New Year as merry and prosperous as your Christmas festival.

To your good health and fortune,

A. K. GRIFFITH,
Dominion President.

NEW ZEALAND ELECTRONICS INSTITUTE (INC.)

I have pleasure in conveying, through the courtesy of Radio and Electronics (N.Z.) Ltd., my sincere good wishes for Christmas and the New Year to all members of the N.Z.E.I. and the Electronics profession.

I take this opportunity of recording my appreciation of the loyal support of the Council and Officers and Members of the Institute throughout the past year, and of congratulating the Wellington Branch on the successful completion of their television project.

L. H. MARTIN,
President.

N.Z.A.R.T.

I would like to thank the Editor of this journal for this opportunity given me to convey these Christmas greetings from the radio amateurs of New Zealand to all its readers. Also, on behalf of the Council of our Association, I feel I must express appreciation for the column of publicity through which, for the past two years, it has been possible to bring before a radio-minded public reports on the activities of the N..ZA.R.T. If this has resulted in the creating of an interest in the hobby of the radio amateur, then I feel the effort has been well worth while.

The hobby of "ham" radio is one which opens up many different fields for experiment. It can provide such a wide variety of interests, DX, the VHF, and UHF, avenues for real experiment, or just the thrill of contact with fellow amateurs and friends on the air. But, above all, it provides a fellowship which is world wide, a real spirit of comradeship based on a common interest. Those who have been able to travel have found that a "ham" call has been a passport to the different countries of the world.

Through the medium of the Radio Emergency Corps, the "ham" is able to serve the community. Since the corps was formed nearly 25 years ago, many of the sections have been used to provide the essential communications in the search for missing trampers, etc., and on other similar occasions. In times of national emergency, from the amateur ranks have been drawn semi-skilled personnel for different sections of the armed services using electronic equipment. In this way our hobby is turned to avenues of service.

On behalf of the Executive Council and the members of the Association, I would like to extend to the Editor and staff of this magazine, and to all its readers, my sincere good wishes for a HAPPY AND JOYFUL CHRISTMAS and all the best for the coming year.

HARRY F. ARNOLD, ZL3HA,
President N.Z.A.R.T.

NEW ZEALAND RADIO, TELEVISION, AND ELECTRICAL TRADERS' ASSOCIATION, INC.

In conveying to readers of the Radio & Electrical Review Festive Greetings and Besh Wishes for the future, I would like to take this opportunity of extending to all engaged in the radio and electrical industries, the thanks of our Association for the wonderful co-operation we have received over the past year.

Always at Christmastime, we have occasion to reflect on the achievements accomplished, and it is with a great deal of pleasure that as 1956 draws to a close, we can report yet another year of successful trading and an outstanding increase in the work of our Association.

In September of this year, it was a heartening experience to have with us at Wairakei, new mem-

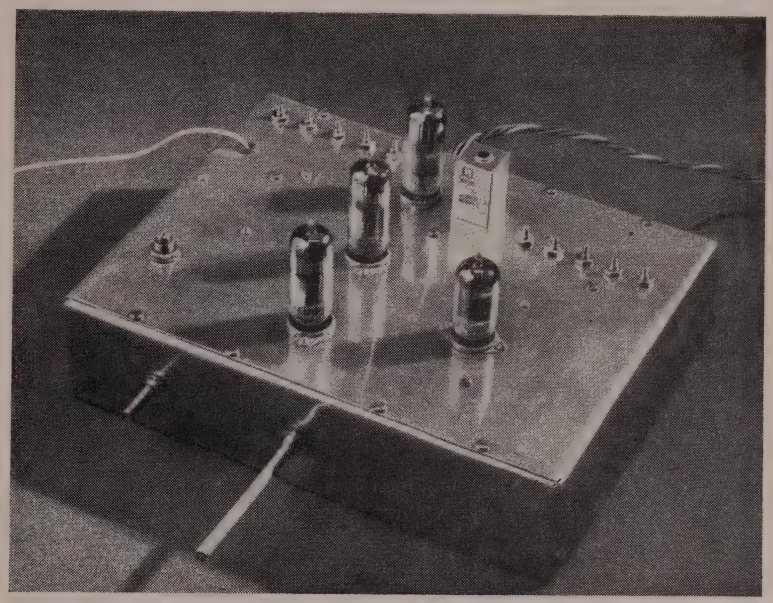
(Concluded on page 49)

A NEW SYNCHRODYNE TUNER CIRCUIT

Such has been the popularity of the synchrodyne for high-quality broadcast reception, that we have been impelled to investigate alternative methods of putting the synchrodyne principle into practice. The article below describes an arrangement which uses no wide-band R.F. transformer and no crystal diodes, and which may appeal to some on that account.

INTRODUCTION

Some measure of interest has been shown by readers of this journal in high-quality reception of broadcast stations, and in the synchrodyne in particular, may be obtained by the number of alternative arrangements we have published since our original synchrodyne design appeared in September, 1954. This article was followed by a Mark II version, which represented slight modifications only to the original, in December, 1955, and January, 1956. Then, in March, 1956, we published a new circuit under the title of "Junior Synchrodyne", this being a little simpler than the original circuits, but still using the same circuit principles. This small spate of articles on what is, after all, a somewhat specialised subject does show how much interest has been shown in it, and serves to emphasize once more the great impact of high-quality sound reproduction in all its phases.



However, one of the things which may have deterred hopeful constructors a little is that, for the synchrodyne circuits mentioned above, special components were needed. Accordingly, we have been at some pains to produce a design which would eliminate these special components, and make the construction of a synchrodyne tuner rather more like conventional radio practice.

The main part referred to here is the special wide-band R.F. transformer which has to be made by the builder, using a not inexpensive Ferroxcube pot-type core. The other special components are the four crystal diodes used in the Cowan demodulator circuit that is the heart of the synchrodyne circuit. These diodes need to be reasonably well matched, or the circuit does not function quite as it should, and besides, though physically small, good crystal diodes are not cheap. It was therefore argued that a synchrodyne that needs none of these things would probably be less expensive to build than our previous circuits, while it might be possible to design one along different lines, whose performance would be in no way inferior.

The present article describes one such attempt. It has successfully done away with the components mentioned, and its bandwidth and distortion appear to be every bit as good as those of the previous circuits. Only in one respect is its performance slightly inferior, and that is in respect of the ease with which it may be locked to the incoming carrier frequency. We will have more to say about this point in a more appropriate place in the article. The new circuit has one very unusual feature which it has achieved purely as a by-product, but which could be very useful. That is to say, the output can be taken in either single-ended or push-pull connection, without any addition to the circuit. Thus, it can feed an amplifier that has no single-ended stages, and which requires a push-pull input signal. Moreover, it is a true balanced output that is provided, much as if the output were from a transformer with a balanced output winding. At the same time, there is no disadvantage at all in taking off a single-ended output from either of the two output terminals.

PRINCIPLE OF THE NEW CIRCUIT

To let readers into a small secret, it may be mentioned that the idea for this new circuit came to us because we had been recently writing, and therefore thinking, about the single-sideband-suppressed carrier transmission and reception. In this sort of transmission, much use is made of a device called the balanced modulator, whose job is to generate a modulated R.F. carrier, and at the same time, to balance out the carrier itself, leaving only the sidebands.

Now, in principle, the ring diode circuit used in the synchrodyne is a form of balanced modulator, and it is well known that balanced modulators may be made using other things than four diodes. It should be possible to use a form of balanced modulator in

which two valves are employed, and this would do away with the four diodes. Also, if the circuit of the balanced modulator is correctly chosen, it should be possible, in addition, to do away with the wide-band R.F. transformer.

At this point, some readers may wonder why we are talking about modulators at all, because what is wanted for the synchrodyne is not a modulator, but a detector, otherwise called a demodulator. The inference to be drawn from the names modulator and demodulator is, of course, that they do opposite jobs, and therefore that they must be quite different from each other. It sometimes comes as a shock to learn that this is not so. There is, in fact, no fundamental difference between a modulator and a demodulator or detector. The difference lies only in the fact that the same circuit can do either job, depending only on how we treat it. Indeed, detection is nothing more than a special kind of modulation.

This statement seems strange at first, because, in general, the circuits commonly used for detection, and well known as such, are hardly ever used for modulation, and vice versa. We thus tend to think of them as entirely different things, whereas, in truth, they are the same thing. The job of a modulator is to take two or more input frequencies and from them to produce new ones; a moment's thought will show that this definition can apply with equal truth to a detector, or demodulator, thus proving our contention of a moment ago.

The "conventional" synchrodyne circuit, reproduced in Fig. 1, has both the input voltages fed to it in a balanced manner, and the output is taken from it in single-ended fashion. The balancing feature sees to it that in the output no voltages at the original sideband frequencies appear. In addition, it is because of the balancing action that ordinary diode detection of the modulated carrier input does not produce any audio output. Such detection is not prevented from occurring, but, instead, the balanced circuit adds two equal voltages of this kind, in opposite phase, so that the resulting output from diode detection is zero. This can be proved by disabling the oscillator, whereupon, if the circuit is properly balanced, there will be no audio output at all. In most actual circuits, perfect balancing does not occur, because of imperfections in the circuit. For example, one such imperfection is that the four diodes are not exactly similar in characteristics. Another is that, however hard we try, it is not possible to produce exactly balanced voltages at the output of the R.F. transformer. In practice, however, the matching of the diodes is not very important, and a well balanced transformer is not difficult to wind, so that it is possible to achieve very good balance.

Other arrangements of the balanced modulator are possible, and one of these has been illustrated in Fig. 2. Here, two diodes are used, and the R.F. signal is fed in single-ended fashion, while the oscillator is fed in in push-pull to the same elements of the diodes. The audio output must be taken in push-pull, and a transformer is shown which enables the actual output to be in either push-pull or single-ended, at the secondary winding. There is no neces-

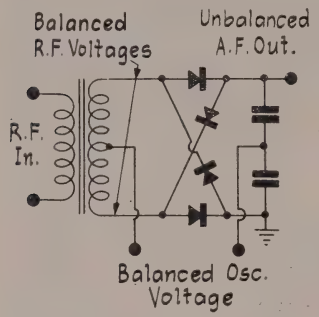


Fig. 1

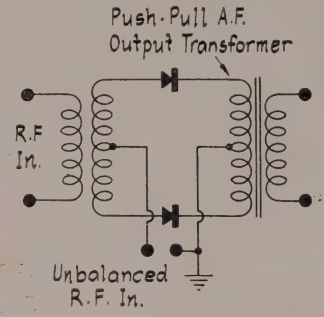


Fig. 2

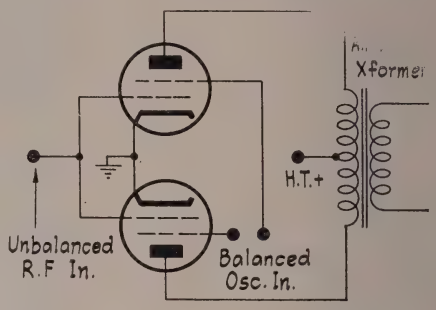


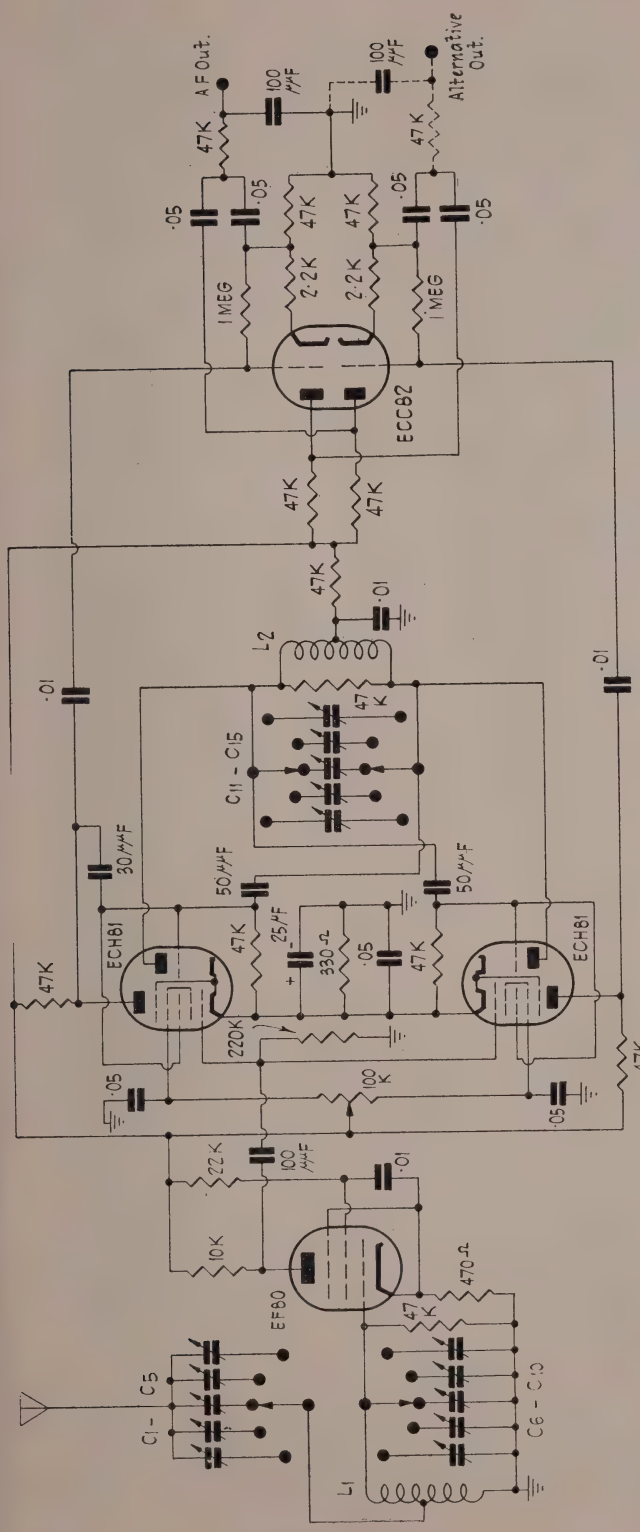
Fig. 3

sity for the valves to be diodes. Triodes can be used, with exactly similar input arrangements, and the balanced-primary output transformer in the plate circuit. However, with both triodes and diodes, there is the difficulty that both inputs must be applied to the same grids. This makes it essential to use the input circuit shown in Fig. 2, which is awkward to construct in such a way that the valves obtain equal in- and out-of-phase voltages. The difficulty can be overcome by using, instead of diodes or triodes, valves which have two control grids. Hexodes, of the kind which are used as mixer valves in superhet. receivers, are very suitable, as they have two grids of reasonably high sensitivity. The R.F. signal can be fed to one pair of grids, and the oscillator voltage to the other pair, and since the voltages are fed to separate grids, the input circuits for the two voltages can also be separate. In Fig. 3 we have shown how such tubes can be used in a balanced modulator circuit, retaining the balanced output transformer. The No. 1 grids are connected in parallel, and the same signal is fed to both of them from the R.F. amplifier, while the oscillator signal is fed to the No. 3 grids, in push-pull, a balanced input transformer being shown on the diagram.

This, then, is the principle of the new synchrodyne circuit.

THE CIRCUIT IN DETAIL

The full circuit reveals some quite noticeable differences between the skeleton system of Fig. 3 and that actually used. First of all, there is a resistance-capacity coupled R.F. amplifier, using a single EF80, whose grid circuit is broadly tuned, as in previous circuits. The full circuit of the balanced modulator is complicated by the necessity of providing cathode bias. D.C. potential for the screen-grids, and the oscillator. Since ECH81s are used, we have available two built-in triodes which can be used for the oscillator



without bringing in a separate valve. In order to make it easier to provide balanced voltages for the oscillator injection grids of the hexodes, the two triodes are used in a push-pull circuit, which generates the balanced voltages directly, without the use of a special transformer. The oscillator coil is not a standard one, and has to be wound by the builder, but this presents no difficulty, as it is a simple solenoid with a centre tap, through which the H.T. circuit is fed to the plates of the valves. The oscillation is secured by cross-coupling the control grids to the opposite plates. Well-balanced push-pull voltages occur at the plates automatically, and coupling to the injection grids of the hexodes is done in the conventional manner, by directly connecting them to the oscillator grids.

The A.F. output of the hexodes is obtained by inserting 47k. load resistors in their plate circuits, and at first sight this seems completely at variance with the requirement that a balanced transformer must be used to take the input from the plates. In practice, this is not so, because a special output circuit using an ECC82 double triode fulfills the essential balancing function of the transformer, eliminating the need for the difficult and expensive component. It might be as well, however, to give some reason for the necessity of a transformer, or at least for something which can "double" for one.

It will be remembered that in describing the diode circuit that was originally recommended by the inventor of the synchrodyne, Dr D. G. Tucker, we mentioned that the balanced modulator circuit was used in order to balance out the audio components produced by ordinary detection on the part of the diodes. Now a hexode, no less than a diode, will produce ordinary detection of any modulated signal fed to it, especially if a high-amplitude oscillator signal is provided as well. Now output from this source is not wanted, because for one thing it will be quite distorted, and, in any case, if we wanted a conventional T.R.F. receiver, we could have made one from scratch without bothering about a synchrodyne at all. Thus, the output of each hexode will have not only the wanted synchrodyne detection components, but also also some unwanted "ordinary" detection products. However, the balanced modulator sees to it that the unwanted components produced by the two tubes are out of phase with each other, so that if the output is taken via a push-pull transformer, the unwanted bits will cancel each other, while the wanted components will add together.

From the above, and a comparison between the present modulator circuit and the one used in our previous designs, it is seen that balancing of the unwanted components can be obtained in at least two ways. If the R.F. signal and the oscillator voltages are both applied in push-pull, the output must be single-ended. This is the arrangement used in our earlier circuits. In the present one, however, the R.F. input is single-ended, and the other two are balanced. A third arrangement is possible, in which the R.F. and output are in push-pull, and the oscillator is single-ended, but this has not been used, since it, too, would involve a balanced wide-band R.F. transformer such as we are attempting to eliminate.

In the present circuit, therefore, the A.F. output must be taken in balanced fashion if the balancing out of the unwanted detection components is to be achieved. Thus, either an A.F. transformer, or a circuit which will fulfill the balancing function of a transformer with a centre-tapped primary, MUST be used.

THE "PHASE COMPRESSOR" CIRCUIT

This circuit will be found in the "Radio Designer's Handbook," fourth edition, where it is recommended either as a means of producing very accurately balanced output voltages from a single-ended input, or for performing the very function we have just been discussing. It consists of a pair of triodes, each of which is connected as a split-load phase inverter. The grids form the two input terminals, and the four "output" terminals of the two circuits are cross-connected by feeding the signals at the plates via coupling condensers back to the cathodes of the opposite valves. The output terminals are then the cathodes of the two valves. The cross-connection is responsible both for the excellent balancing action, and for the cancellation of the in-phase components of output.

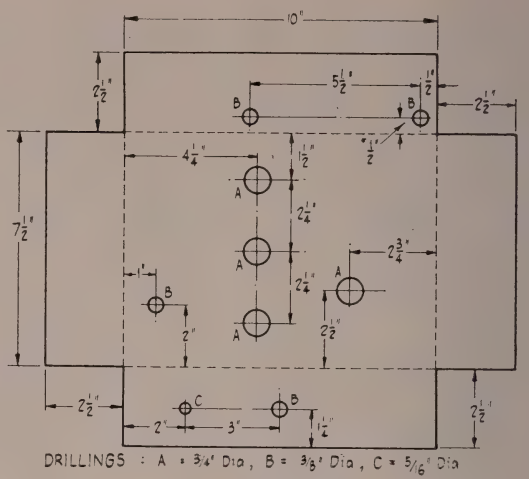
One remarkable result of the use of this circuit is that single-ended or balanced output can be had at will, just as if an actual transformer had been used.

OSCILLATOR LOCKING

An essential feature of the synchrodyne is that the oscillator must be locked to the frequency of the received carrier, in order that the sidebands may be properly converted back into their original audio frequencies, and so that no beat frequency, however slow, exists between the oscillator and the incoming carrier. In this circuit, there appears at the plate of each hexode a voltage at the carrier frequency, so that if this is fed through a small capacity to the oscillator circuit, there is a tendency for the latter to synchronize with the incoming carrier. The condenser referred to is the 30 $\mu\mu$f. one connected between the plate of the upper ECH81 and the injection grid of the same valve. The voltage at the plate is thus fed through the grid-coupling condensers to the grids of both oscillator triodes.

MODULATOR BALANCING

Throughout the above discussion of the balanced modulator, it has been assumed that the two tubes are identical, because, if they are not, balancing of the in-phase detection components will not be complete. It is too much to expect that the characteristics of the two hexodes will, in fact, be identical, so that, to get over the difficulty, a balancing control is provided in the shape of a differential control over the screen-grid voltages. If the oscillator is de-tuned so that a heterodyne with the desired signal is no longer heard, some audio output, representing the unbalanced detection products of the hexodes, will be audible. This will be due to any unbalances in the modulator circuit, and can be compensated by the use of the 100k. potentiometer as a balancing control. It is adjusted until the audio output under these conditions is a minimum, and in practice it will be found that only an exceedingly small audio output from this cause remains when the potentiometer is properly adjusted. If the combined cathode currents of the two hexodes is measured while the balancing pot. is adjusted, it will be found that a position exists at which the total cathode current is a minimum. This represents the point of D.C. balance, at which the cathode currents of the two tubes are equal, and if the tubes are well balanced dynamically (i.e., as far as amplification is concerned) the setting for minimum audio output with the oscillator de-tuned will be very close to the setting that gives minimum cathode current. If the two are widely different, it would be a good plan to get another ECH81, and find a pair from the three which gives the closest D.C. and dynamic balance. Once the potentiometer has been adjusted in this way, it need not be touched again unless a tube is changed.



THE R.F. AMPLIFIER

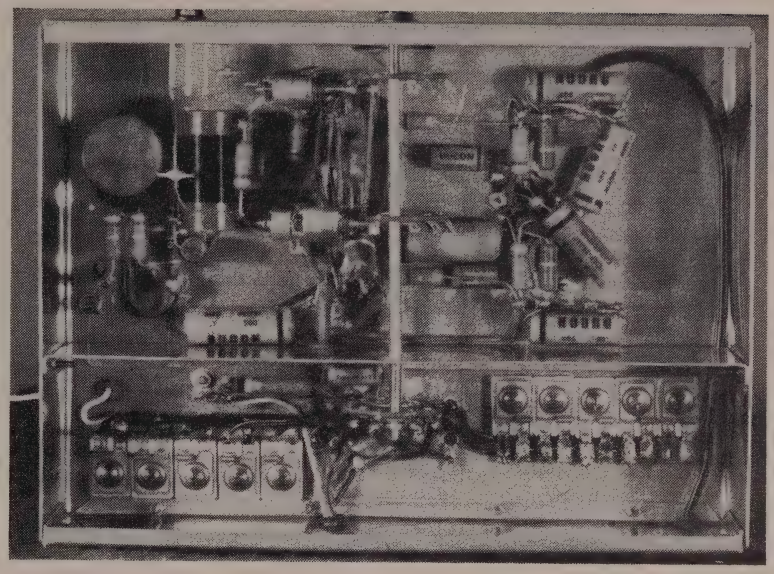
This circuit, like all the other synchrodynes we have described in these pages, uses pre-set tuning of the stations, and a selector switch. C_1 to C_5 are semi-variable condensers, used for equalizing the strength of the signals from the five stations provided. Thus in use, the aerial is made of such a length that a strong enough signal is obtained from the weakest station to enable satisfactory locking to be had, after which the series condensers are used to reduce the signal strength from the remaining stations in such a way that the audio output from all of them, when fully modulated, is approximately the same. Of course, before this is done, each station must be accurately tuned in with C_6 to C_{10}. The tuned circuit formed with these condensers by L_1, which is a conventional aerial coil of the car-radio variety, is not very selective as it is used here, because it is shunted by a 47k. resistor, which considerably reduces its Q and thus prevents it from cutting the all-important higher sidebands that the synchrodyne is at pains to reproduce.

Since the EF80 is a high-Gm. valve, intended for video amplification, it gives a reasonably constant gain across the entire broadcast band with its load of 10,000 ohms. The gain is rendered more constant over the band by the omission of the cathode bypass condenser.

CONSTRUCTION

This is well illustrated by the two photographs printed here. The chassis measures 10 in. x 7½ in. x 2½ in., and is made with the top and sides in the form of a "U," with the front and back separately fabricated and inserted after the wiring-up has been

completed. The aerial coil and the EF80 can be seen at the back of the chassis, together with the two rows of pre-set condensers, all of which are made from 800 $\mu\mu$f. padders. Plates are removed from those used at the high-frequency end of the broadcast band in order that they may all be adjusted with the screws fairly tight, thus helping to prevent drift in the capacity, although drift in these components is not at all important, since the stability of the whole tuner is tied up with that of the oscillator.



The two tubes directly in front of the EF80 are the ECH81s, while the remaining one, off to the right of the chassis, is the ECC82.

The main point to note about the under-chassis wiring is the construction of the oscillator circuit. The coil is wound on a piece of bakelized paper coil former one inch in diameter, and the coil connections are made to solder lugs riveted to the former. The latter is very light, and is mounted simply by soldering one of the aforementioned lugs to one of those on a tag-strip that is fixed to the chassis to the left of the coil. This method gives quite reasonable rigidity, which is enhanced by the connection of the lead wires and other components to the remaining two lugs. The one by which the coil former is mounted is the one which connects to the centre-tap, and it can be seen that the other two, for the ends of the coils, are disposed so that the leads come away symmetrically from it to the switch. The latter uses two wafers for switching the ends of the oscillator coil to the tuning condensers, not because two are needed in order to obtain the necessary number of switch points, but so that one wafer can be used for each end of the coil, thus making the circuit symmetrical as a whole. It will be seen, indeed, that half of each wafer is unused.

Notice that a shield compartment goes right across the chassis and serves the dual purpose of shielding the R.F. amplifier stage from the rest of the circuit, and of supporting the end of the switch assembly. The oscillator tuning condensers are all made up of fixed capacity in parallel with a single Philips trimmer for each station. The trimmers are mounted directly on to the switch lugs, and the fixed condensers can be seen going between corresponding lugs on the two switch wafers. Not shown on the circuit diagram is an 8 $\mu\mu$f. butterfly variable condenser which is used as a front panel fine tuning control, to take care of oscillator drift during warming up, etc. It is connected across the tuning coil with two 10 $\mu\mu$f. fixed condensers in series with it, one on either side, to preserve balance, and also to limit the range of frequency variation provided by it. It can be clearly seen in the under-chassis diagram together with its series condensers, which are of the disc ceramic type, and appear on edge in the photograph.

The whole of the ECC82 circuit appears on the right of the switch, and the output is taken via a piece of microphone cable round the right-hand side of the chassis, and out through a grommet in the back. Heater and H.T. voltages are supplied from a separate power supply through the four-wire cable which issues from the centre of the back of the chassis. The balancing potentiometer can be seen to the left of the coil in the underneath photograph. It can be some distance from the ECH81s, because it is purely a control of D.C. volts, and because the screen pins of the valves are bypassed to earth right at the valve sockets.

SETTING UP THE CIRCUITS

Some of the procedure for doing this has already been given under the heading of the circuit description, so that very full instructions should not be needed at this stage. Compared with previous circuits, which have mostly used transitron oscillators, the oscillator of this version is not so easy to lock, and this is the chief price paid for the lack of special components. Locking oscillators to the incoming carrier is in some ways a paradoxical business, in that the greater the natural stability of an oscillator the more difficult it is to lock. It is very noticeable about this circuit, for example, that the push-pull oscillator is very stable indeed with respect to such things as variations in the H.T. supply voltage. This might be reckoned a good thing, as one would expect that once locking had been obtained, the oscillator would be unlikely to drift out of lock. Unfortunately, however, exactly the opposite takes place. Once the chassis has warmed up, it is very stable indeed, and requires little or no manual adustment, but because it is impossible to produce a very tight lock, as it is with the transition oscillator, drift during the warm-up period is much more in evidence. However, the performance after the initial warming-up period is quite satisfactory. One way of making the circuit lock more tightly is to reduce the Q of the oscillator coil, and this has been done by connecting across it a resistor of 47k. Doing this, however, reduces the oscillator output, and in order to restore it it becomes necessary to increase the H.T. voltage on the oscillator valves.

(Concluded on page 51)

THE AMATEUR RADIO EMERGENCY CORPS

The Amateur Radio Emergency Corps was founded as a result of the Napier earthquake, when the only communications from the Napier area for several days after the disaster were from an amateur radio operator's station. Amateurs, as a result of this experience, saw an opportunity for them to perform a useful public service. The strength of the corps today has grown to approximately 450 members in sections which are located in various centres from Whangarei to Invercargill.

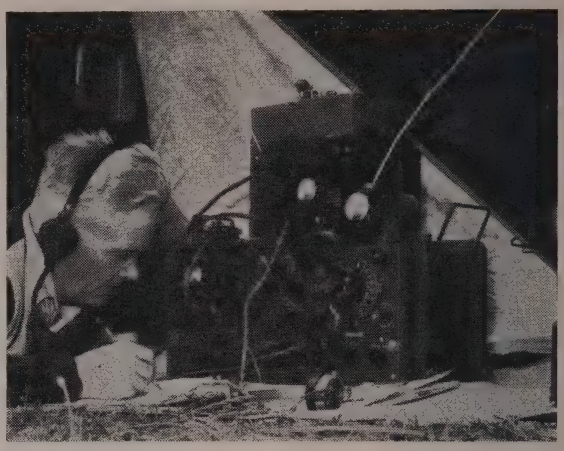
The Amateur Radio Emergency Corps has been very active for some twenty-five years, and it has in the past found difficulty in obtaining recognition due to the fact that it is an "amateur" organization, but, like many other similar voluntary organizations such as tramping clubs, it has proved that under adverse emergency conditions a task can be done and done well. Official recognition has only been gained by the hard path of ability to do a job.

The amateur provides a unique public service by virtue of his knowledge and location throughout New Zealand, which could not be provided by any other service. Each section of the A.R.E.C. is self-contained, but it can also be grouped into an area communication link, and equipment can be transferred as requirements demand. This is possible due to the recognition the A.R.E.C. has received from the Government in the form of grants of equipment enabling standardization throuhout the corps. Nearly all sections are equipped with the New Zealand-made wartime transceiver ZC1. Eighty in all have been made available to the A.R.E.C., and these have been distributed to as many sections as possible, keeping in mind the areas which have the highest emergency probability.

The amateur service is provided on a purely voluntary basis, and much time is spent by members keeping themselves prepared for any emergency. Many sections are included in Red Cross and St. John Ambulance organizations, and in the main city E.P.S. organizations the Amateur Radio Emergency Corps has been asked to assist in the communication network.

When the National Search and Rescue organization was formed some five years ago, the value of the Amateur Radio Emergency Corps was recognized, and the amateur service was included in the communication plan. In all major searches that have been carried out since the formation of the national organization, the A.R.E.C. has been responsible for the forward communications, and in many instances communication back to the search room. In all cases the communications have worked perfectly, earning the commendation of those controlling the search.

At present a new portable transceiver is under consideration for replacing the present sets used in search areas which are forward of search headquarters. The set has been designed by people who have had experience in searches in conjunction with some of the radio engineers who are members of the Amateur Radio Emergency Corps. The set is small and lightweight and will be produced by members of the corps in the larger centres under the guidance and supervision of the radio engineers in our ranks. The sets will all conform to set specifications before they are distributed to all sections. Approximately 120 will be required.



Jim Pierce, ZL2LG, operates a ZC1 at an A.R.E.C. field-day. —Photo by Leo Johnston, ZL2VR.

A national field day was held on 25th November, when A.R.E.C. sections throughout New Zealand took part. The exercise had been planned to give message handling practice to all operators and to try out communications on a Dominion-wide basis. Briefly, New Zealand was divided into its four areas in accordance with the Search and Rescue Organization's plan, and outpost stations worked into their respective base stations; base stations in turn, working into their area control, and area control stations contacting headquarters in Wellington. Approximately 100 A.R.E.C. stations were active, throughout the day.

Members of the Amateur Radio Emergency Corps are all licensed amateur radio operators—that is, they have passed an examination in radio theory and morse code as required by the Postmaster-General. Amateurs, through practice with the general activities of their hobby, obtain a rare ability to hear and copy weak radio signals together with a practical knowledge of many aspects of radio communications. This ability and experience, together with the ideal of performing a service to the community, ensures that the Amateur Radio Emergency Corps can always be relied upon to carry out any task required.

The Amateur Radio Emergency Corps is justly proud of its heritage, a heritage members jealously guard.

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USING THE "R. & E." TAPE-RECORDING CIRCUIT WITH THE BRENELL DECK

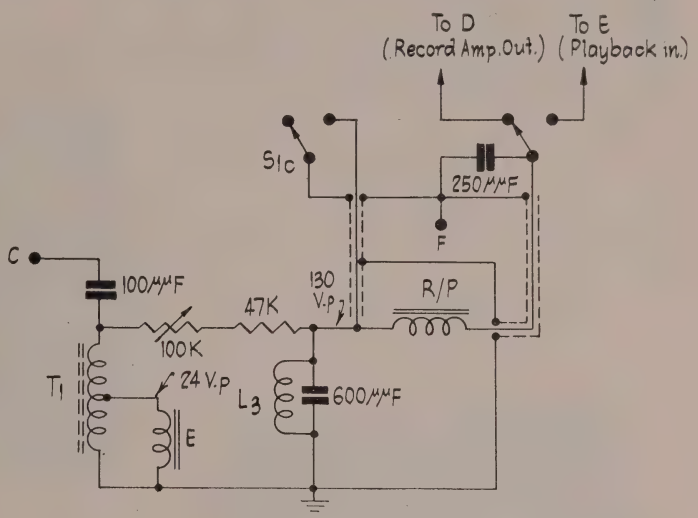
Last month we published the information required by those who wish to use our tape-recording circuits with the "Collaro" deck. This month we are doing the same for another popular deck—the "Brenell". Thus, the circuits will be found suitable for use with three excellent decks that are available on the New Zealand market.

INTRODUCTION

Those who have purchased Brenell tape decks, or who are thinking of doing so, and who wish to use the "R. & E." tape circuits, recently published, will need this short article in order to carry out the required modifications to the original equipment. Fortunately, the modification is extremely slight, because the Brenell is of the same basic kind as the Truvox. That is to say, the switches on the deck control only the functions of the deck itself, and have no direct bearing on the amplifier circuits, which must be switched separately. For this reason, **the original amplifier and bias supply unit described for the Truvox deck should be built exactly as originally specified.**

LOW-IMPEDANCE ERASE HEAD

The only respect in which the circuitry for the Brenell deck needs altering, is that this deck has a low-impedance erase head. Indeed, examination of the two seems to show that the heads are identical with those used by the makers of the Collaro deck. The measurements taken in our laboratory, and the performance obtained with the Brenell deck bears out this supposition. Thus, it is necessary to wind a step-down transformer, exactly as for the Collaro, which is substituted in the original circuit for the high-impedance erase head of the Truvox. From this it can be seen that the only circuit that is changed is that of the small sub-assembly, mounted under the deck close to the heads, and containing the transformer, the tuned circuit and the adjusting resistor for setting the bias voltage correctly. This has been specially drawn again for this article, and appears herewith. The transformer is wound on a Ferroxcube core, type D25/16/3B3. The winding comprises 271 turns, tapped at 21 turns from the earthed end. It is wound with 34 S.W.G. enamelled wire. Another minor circuit modification is the inclusion of a 47k. fixed resistor in series with the 100k. variable adjuster. The reason for this is that the transformer has a higher Q than the original Truvox erase head for which the circuit was designed, so that a greater H.F. voltage appears across it, making the 100k. resistor too small to allow a low enough voltage to be fed to the R/P head for bias. Adding the 47k. resistor allows a greater range of amplitude to be obtained, and ensures that it is possible to secure the correct bias voltage across the R/P head. In the Brenell deck, as in the Collaro, both leads from both heads are brought away from the head in shielded pair, so that it is not necessary, as with the Truvox, to fish out the "cold" end of the R/P head in order to use our head circuit.



Bias and erase voltages required by the Brenell were found to be identical with those needed by the Collaro, and this is sufficient proof in itself that the heads are identical on the two machines. For those who may not have seen last month's article, it may be mentioned that using BASF tape, as we have done all along for purposes of specifying the adjustments, 17½v. R.M.S. across the erase head, and 91v. R.M.S. from the bias end of the R/P head to ground, were the amplitudes found to be correct. We should perhaps mention here that when measuring these voltages, one must be certain that the V.T.V.M. used is still correct at a frequency of 60 k/sec. Some V.T. voltmeters, arranged for audio frequency work, do not go as high as this, so that it is necessary to use one that is rated for use at radio frequencies if the right answer is to be obtained.

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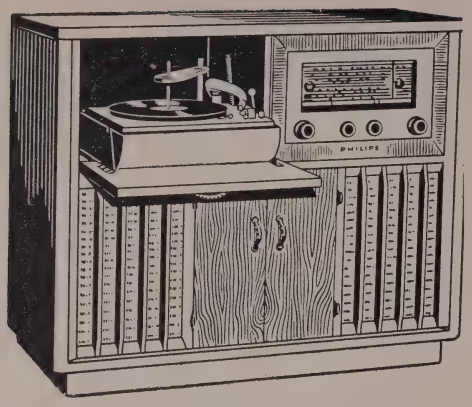

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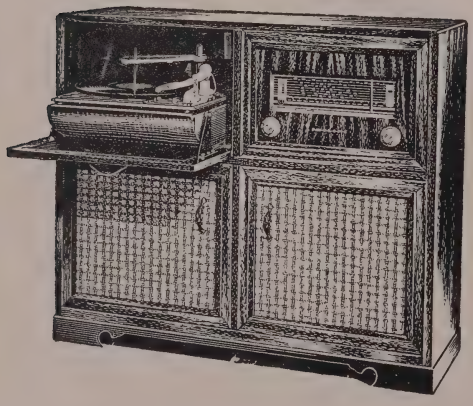

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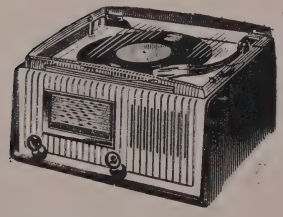

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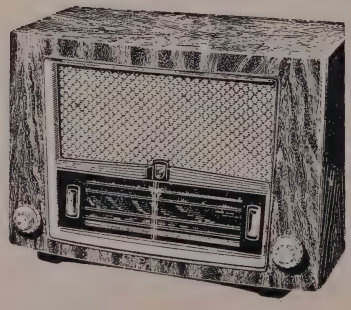

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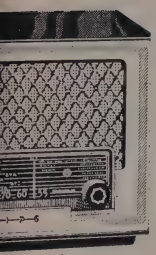

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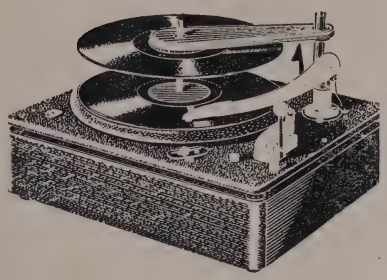

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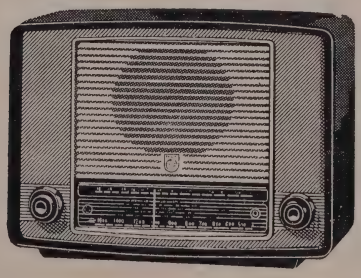

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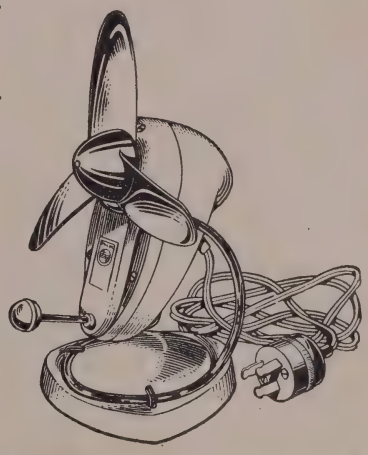

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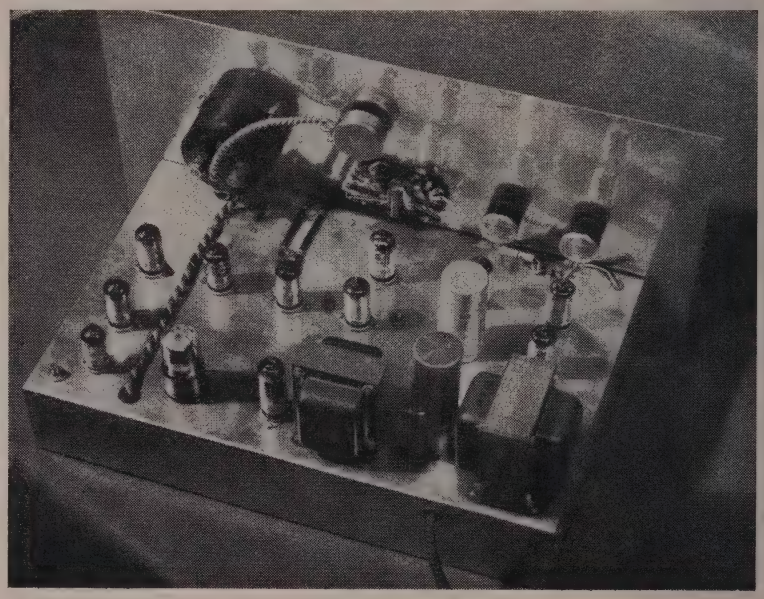
Measurements

AN AUDIO FREQUENCY INTERMODULATION METER—Part 2

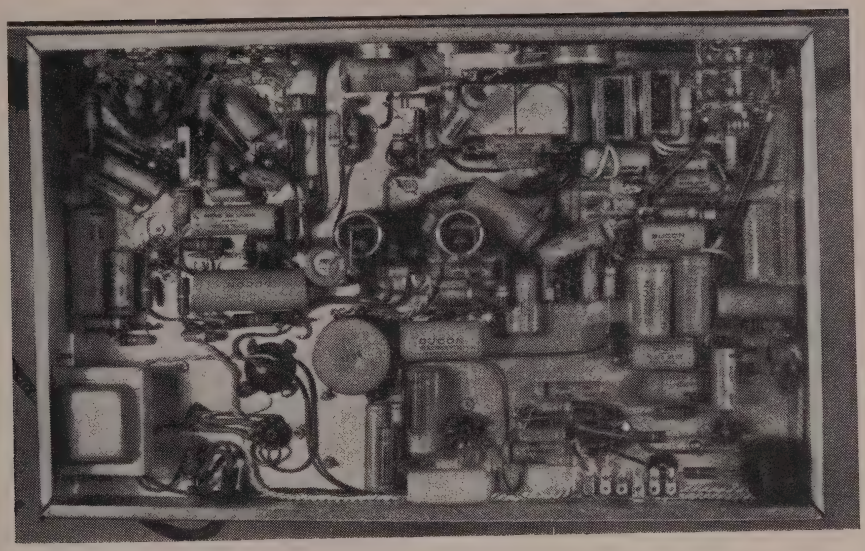
Continuing the description of the circuits and performance of the intermodulation meter, the first part of which was featured in last month's issue. In this instalment, will be found the details of the detector, low-pass filter and metering circuits.

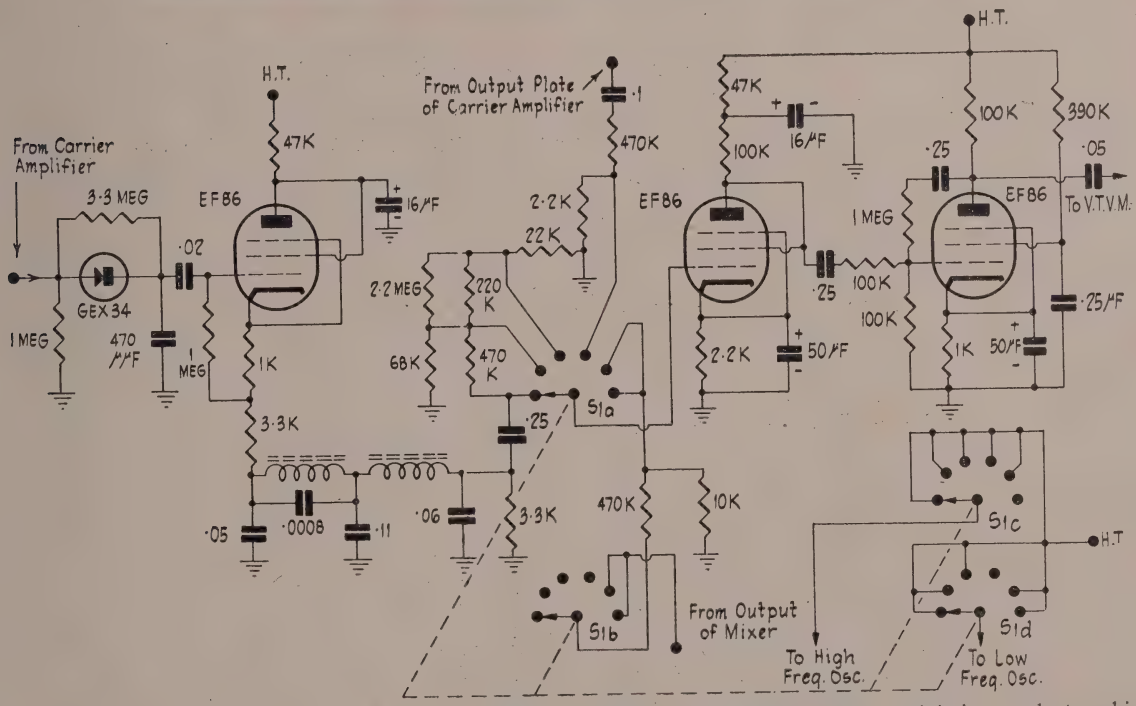


For the benefit of those who may not have read the first part of this article, a brief recapitulation of the scheme of the instrument will be useful. It employs the S.M.P.T.E. method of intermodulation measurement, with the exception that the final metering circuit works on a peak-sum basis rather than measuring the R.M.S. sum of the distortion products. This has been done on the principle, suggested by Langford-Smith in the 4th edition of the Radio Designer's Handbook, that the peak sum method should give better correlation with listening sets than the R.M.S. sum method, since it automatically places more emphasis on the importance of the higher order components, which are more likely to be annoying to the ear during the reproduction of music. Thus, the first portion of the instrument follows conventional lines, using a two-tone test signal, with a 4 : 1 ratio between the amplitudes of the mixed low and high-frequency tones. A mixer circuit is provided which is free from intermodulation itself, so that the instrument is completely self-contained. The measuring circuit proper commences with a cathode-follower whose purpose is to provide a high-impedance input terminal, and at the same time allow of matching to the impedance of 3.3 k., for whic hthe next item, namely the high-pass filter, is designed. Following the two-section constant-k high-pass filter is an uncalibrated attenuator, comprising two sections giving 20 db. each, followed by a continuously variable potentiometer. The purpose of the attenuator is to allow the input to the remainder of the circuit to be adjusted to a standard amplitude, irrespective of that from the device under test. Following the attenuator is an amplifier whose gain, stabilized by negative feedback, is such that an output of 10v. peak can be obtained from an input signal of approximately 64 millivolts peak. The figure of 10v. peak was decided upon as a suitable level at which to work the demodulator, whose function is to detect the modulation of the high-frequency tone, and pass it on to the metering circuit for quantitative measurement. The gain of the first amplifier was determined by the desirability of being able to measure the distortion in small voltages, and by the inevitable loss in the input cathode follower circuit feeding the high-pass filter. Thus, since the demodulator works at a fixed input level, regardless of the output amplitude of the device under test, the amplifier following this filter is arranged so as to have enough gain to cope with the agreed minimum signal, and the attenuator ahead of it takes care of the majority of measurements, which are of voltages considerably in excess of the minimum.

DEMODULATOR AND LOW-PASS FILTER

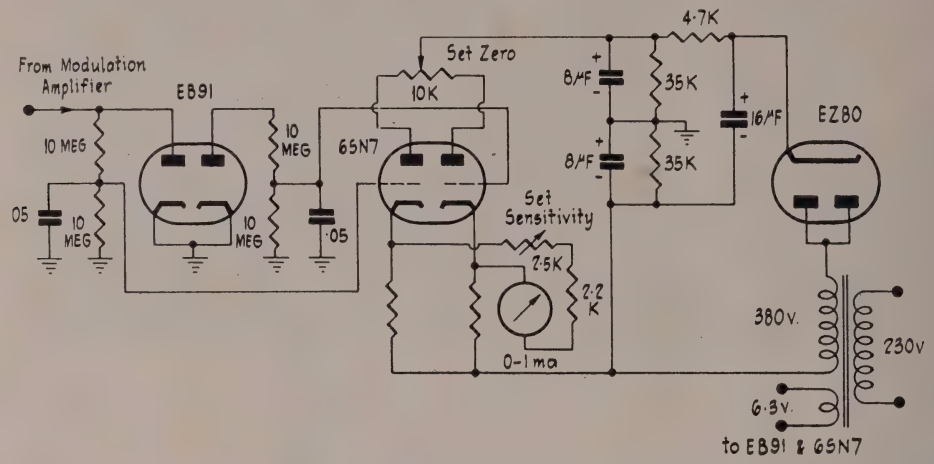
This brings us to the first circuit printed in this instalment, which shows the demodulator. low-pass filter, and meter amplifier, together with the switching that is incorporated to enable the instrument to be set up and used with the best possible expedition and ease. The signal input is from the amplifier, already mentioned, which has been designated the carrier amplifier. No blocking condenser is shown on this diagram, as this was incorporated on the previous one. The demodulator circuit is one culled from servo-mechanism practice, in which the problem is similar to the present one, namely to obtain efficient detection of modulation components belonging to a carrier that is not, as in radio practice, high in frequency compared with the modulation. In a case like this, it is not possible to devise a simple circuit





high-efficiency detection, and at the same time complete rejection of the residual carrier components. Thus, the demodulator is followed by a cathode follower, whose purpose is to match the high output impedance of the demodulator circuit to the low impedance of the two-stage low-pass filter. The latter removes the carrier and its harmonics, leaving only the modulation components, which are passed on to the metering circuit. The filter circuit is designed with a cut-off frequency of 1000 c/sec., and has one m-derived section, and one constant-k section. The choice of cut-off frequency is a compromise between accepting the higher modulation products, which may have frequencies of several times the lower test frequency, which is the modulated carrier. The two requirements are conflicting, so that the best compromise is a cut-off approximately mid-way between the highest of the three low-frequency test signals and the lowest of the three high-frequency test signals. Those chosen are 40, 160, and 400 c/sec. for the low-frequency signal, and 2000, 4000, and 8000 c/sec., for the high-frequency one. Fortunately, the best equipment will, in general, be tested with the lowest and highest of these frequencies

in combination. In this case, modulation components up to the 25th harmonic of the low-test frequency will be accepted by the measuring circuit. For testing poor circuits, such as are met with in simple broadcast receivers, a higher L.F. test tone is advisable as is a lower H.F. test signal, and in this case, only second order intermodulation products will be measurable if the 400 c/sec. L.F. tone is employed, but this is little of a disadvantage, since the whole



method is really one of measuring the low-frequency distortion of the tested equipment. Thus, if a 400 c/sec. test is not searching enough in a particular instance, it is always possible to make the test more stringent by using one of the lower test frequencies. The provision of the lower H.F. test frequencies is again in order to have a more realistic approach to the performance of equipment of poorer quality, for in general it will not be possible to use 8000 c/sec. with such equipment, and with some, even 4000 c/sec. may be too high. The testing of equipment with purposely restricted frequency response is also facilitated by having 400 and 2000 c/sec. frequencies available.

The switch S_1 requires some explanation. It acts in three capacities, and the relatively complex nature of its action is called for by the necessity to make the instrument easy and quick to use. In the first place, some means is needed for checking that the ratio of the L.F. to H.F. amplitude in the test signal is always 4 : 1. Since the complete instrument incorporates a high-gain V.T. voltmeter, it is economical and convenient to use this voltmeter for all setting-up checks like this one, so that S_1 has two positions which enable the relative oscillator amplitudes to be checked rapidly. These are the positions on the clockwise end of the switch as drawn. The output of the mixer circuit which combines the two test tones is taken to S_{1b}, in these positions. From the first two contacts of this wafer, which are bridged, is a potential divider whose output goes to the corresponding contacts on S_{1a}. This wafer feeds the grid of the first stage in the metering amplifier, which is used for all measurements, changes in full-scale reading being made always by the use of appropriate potential dividers. The one connected between S_{1b} and S_{1a} is arranged so that with the normal outputs from the oscillators, approximately half-scale deflection is obtained when only the L.F. one is on. The wafers S_{1c} and S_{1d} supply H.T. voltage to the two oscillators, and turn these on and off in the appropriate sequence. Calling the clockwise position of the switch No. 1, and the others in sequence, with anti-clockwise rotation, the switch's action is as follows. In position 1, the L.F. oscillator is on, and the H.F. oscillator is off. A suitable red mark is made on the meter scale, and the L.F. oscillator's ampliture is set to this value with its output control. A second red mark appears on the scale at 5/4 the reading of the first one, so that to set up the proper oscillator output ratio, the switch is then moved to position 2, at which both oscillators are on. The control of the H.F. oscillator is then adjusted to bring the reading to the upper red mark.

In position 3, we have the "set carrier" position. In use, after the oscillator amplitudes are set, the test device is operated at the desired level by adjusting the input amplitude control, which follows the mixing circuit, and which does not affect the amplitude ratio previously set up. The instrument is then put into the "set carrier" switch position, in which the L.F. oscillator is turned off, leaving only the H.F. signal. At the same time, S_{1a} connects the meter amplifier input to the output of the carrier amplifier, at the point where the carrier is fed to the demodulator. The potential divider has previously been adjusted, during the construction of the instrument, so that an output of 10v. peak from the carrier amplifier gives a full-scale reading on the meter. After this, the meter switch can be moved to the next position, which is the first reading range, and reads 0 to 100%. If the reading is too small for this range, the switch is moved to the next position, in which the scale reading is 0 to 10%. The fifth position reads 0 to 1%. Thus, it is seen that the network of resistors attached to S_{1a} in its last three positions are arranged so as to feed one hundredth, one tenth, or all the output from the low-pass filter to the meter amplifier, depending on which measuring range is to be used. Calibration is then effected by adjusting the gain of the meter amplifier, during construction, so that a low-frequency output corresponding to, say, 10% modulation of the carrier, gives a reading one tenth of full-scale when the meter is on the 100% position.

THE METER AMPLIFIER

The sensitivity required in the measuring circuit can be gauged by the fact that if the carrier amplitude is 10v. peak, and the modulation is 1%, the peak amplitude of the measured signal will be 100 mv. peak; this, in conjunction with the decision to build up the signal to a 10v. peak level at the voltmeter rectifier, calls for an amplifier gain of 100 times. On account of the losses in the cathode follower feeding the low-pass filter, however, the meter amplifier's gain must be higher than this, and the exact figure was arrived at experimentally by arranging a 10v. peak signal at the input of the cathode follower, and adjusting the amplifier gain, with the switch in the 100% position, until a 10v. peak signal was delivered to the V.T.V.M. rectifier by the amplifier. In order to reduce hum in the meter amplifier, the first stage was arranged as a 'straight' amplifier with a plate load resistance of 100k., and a bypassed cathode resistor. The remaining amplifier gain was provided by a second stage, with plate-to-grid negative feedback. This feedback was used as a means of varying the overall gain during calibration, since the small changes in amplification could be arranged easily, using relatively large changes in the feedback resistor in the second stage.

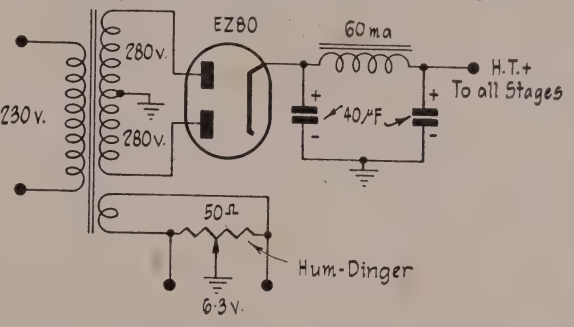
THE V.T.V.M. CIRCUIT

This circuit is a well-tried one which has the virtues of excellent linearity above inputs of 1 volt, excellent stability, and simplicity. Arrangements are incorporated for balancing out the contact potential of the measuring diode, and the input impedance is of the order of 4 megohms shunted by a capacity of 6 $\mu\mu$f. As a result, the performance as a peak-reading voltmeter is excellent provided that the source-impedance of the voltage being measured is not too high. As used, this source impedance does not rise higher than about 200k., at any of the measuring positions.

PERFORMANCE OF THE INSTRUMENT

Building an instrument of this nature is a major undertaking, and the ultimate performance must be up to expectations if all the work put into it is to be worth while. It is consequently of some importance to check the accuracy of the indications when the instrument has been completed. The first check made was for residual hum, noise, and intermodulation. This is done by feeding the two-tone test signal directly from the mixer circuit. to the measuring circuit, without the intervention of any equipment under test. Ideally, such a check should result in a reading of zero, but such a reading could be obtained only if the oscillator mixing circuit were entirely free from intermodulation, and if the total amplification provided by the instrument were free from noise, hum, or other disturbances. Since a full-scale range of 0-1% has been provided, it was expected that the residual components would be readable, since there is a total amplification of some 25,000 times, not counting the D.C. amplification in the meter circuit. However, on carrying out the test, with the attenuator fully out of circuit, so that the smallest possible work signal was used, it was found that the residual reading, including all the sources mentioned, corresponded to an IM reading of 0.05%. Some authorities state that when this method is used, reading below 0.4% tend to become meaningless on account of the effects on the readings of small quantities of distortion in the oscillators. It can be seen, therefore, that the readings of the present instrument should be reliable down to the minimum useful reading of the method. In order to check the readings in another way, the oscilloscope was used to display the waveform of the modulated carrier, at such an amplitude that measurements of intermodulation could be made by LeBel's oscillographic method. (loc. cit.) The accompanying graph shows the correlation between the two methods that was obtained. It will be seen that at high levels of intermodulation, the meter reads high compared with LeBel's method, but that at low IM percentages, the correspondence is very good.

The other diagram is a reproduction of the test results taken on an amplifier designed and built in our laboratory. It will be seen that the distortion is very small at all power outputs up to the clipping level—less than 2% IM—so that the amplifier in



question complies with the criterion which Langford-Smith gives as "extremely high-fidelity". While we cannot altogether subscribe to the terminology, it is at least gratifying to find that an amplifier designed and tested **without** the benefit of any accurate equipment for measuring distortion gives such excellent performance.

An interesting point about the curve is the apparent increase of distortion at very low output levels. This would seem to be due to the residual reading of the meter, at least in part, and appears to bear out the contention that figures obtained by this method, less than about 0.4% have little significance.

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AMPLIFYING SINGLE SIDEBAND

INTRODUCTION

One of the points frequently stressed as an advantage of S.S.B. transmission is that modulation is almost invariably done at a very low level. It certainly is an advantage, so far as cost of modulating equipment is concerned, but a question immediately presents itself, viz., what do we do next? True, no one wants to transmit a power of only a few milliwatts, and very few are contented with a few watts. Tens of watts are the thing, even if there is a 9 db. advantage in S.S.B. transmission. The answer, like many things, is not immediately obvious until it is pointed out, and the short one, which is "Use an R.F. power amplifier, of course!", needs more than a little qualification, particularly if it is to be of any use to the newcomer to single sideband.

WHAT SORT OF AMPLIFIER?

In the first place, when amplifying a single-sideband signal **it is not possible to use a Class C amplifier.** (Bad luck, as 1066 & All That would say). It actually is unfortunate, but there is just no way round the problem. A Class C amplifier just can't be used on an S.S.B. signal. Why? Because if it is, the sideband becomes horribly distorted, and would be unrecognisable afterwards. The reason is actually exactly the same as the one which prevents us from using a Class C stage to amplify an already-modulated carrier. In fact, once modulation has been effected, a linear amplifier of some sort must be used. That is to say, an amplifier whose output voltage is strictly and accurately proportional to its input voltage. The only kinds of amplifier which have this property are those which work in Class A, Class AB, or Class B. This, incidentally, is why the sort of amplifier usually used for handling modulated signals is called a Class B **linear.** Of course, it doesn't follow that because a tube is worked in Class B, its output will be a linear function of the input. It won't unless someone who knows his stuff has adjusted it properly.

In ordinary A.M. practice, it is unheard of to use a Class A or AB amplifier following a modulated stage, and it is well known that this is because their efficiency is always much smaller than that of a Class B stage. Why, then, talk about A and AB in connection with single-sideband amplification? Well, at high power levels—higher than those we are authorized to use on amateur bands in this country—Class B stages still hold the floor because of their superior efficiency, but at lower powers, the situation is similar to that with audio amplifiers. First of all, reasonably small tubes can deliver several watts, or even several tens of watts, without being run into grid current, so that for small powers there is no need to go to Class B amplification. Indeed there are advantages in not doing so, just as there are if you are interested in high-quality audio amplification. For example, as always, the best linearity, or the least distortion, which is the same thing, is obtained with push-pull triodes, so that for low-powered S.S.B. transmitters, and for low-powered driver stages for high-powered amplifiers, it is not only possible, but advisable, to use a Class A stage, which as usual can be either single-ended or push-pull.

WHY WORRY ABOUT DISTORTION...

Looking at the problem of amplifying S.S.B. one might well wonder why a little bit of distortion in such an amplifier is worth worrying about. For example, its input and output circuits will be tuned, so that as with C.W. amplifiers, the tuned circuit will supply the missing portion of the R.F. cycle if the valve becomes cut off during part of it. Furthermore, suppose that distortion does take place; the harmonics will be multiples of the R.F. components that make up the sideband being amplified, and these harmonics will be well and truly rejected from the output by the tuned tank circuit, and also by any aerial tuning arrangements that may be provided. This being so, why does the generation of harmonics matter at all?

Unfortunately, there are some fallacies implicit in these two questions which provide the answers, when they are recognised as such. In the first place, if the amplifier is producing distortion, this means that the output is not a linear function of the input. When the input is a sideband, it contains numerous frequencies, all in specific relationship to each other as to amplitude. A non-linear amplifier, therefore, will destroy the correct amplitude relationship between the various components of the sideband, so that although it may still contain the correct frequencies, it will have their relative amplitudes all wrong, and the sideband comes out of the amplifier very differently from the way in which it entered.

Secondly, if an amplifier is distorting, it does not only produce harmonics of the input frequencies. It is quite true that if it does, the tuning of the amplifier and subsequent circuit will remove those harmonics, but they cannot remove the other distortion products. Everyone interested in audio amplifiers these days has heard of intermodulation distortion. Well, this is the main offender here. If an S.S.B. signal is passed through an amplifier which distorts it, the result is that as well as plain harmonics, intermodulation products are produced. These represent beat frequencies, which occur between every frequency in the signal, and every other frequency in it. These beats will largely fall inside a band close to the sideband itself, and also inside it, so that we end up not with a nice clean, undistorted signal, but one which is overlaid with intermodulation products, and which also has unwanted signals next door to it, as it were, in the position which would be occupied by the other sideband had it not been purposely removed. Also, should there be any residual carrier with the S.S.B. signal, this will beat with all sideband components to produce the other one again—after we have gone to all that trouble to eliminate it in the first place!

SOME PRACTICAL PROBLEMS

This, then, is why S.S.B. signals may be handled strictly by "linear amplifiers only". Remembering the large advantage in effective power output obtained by the use of S.S.B., it is obvious that quite hefty

signals can be put on the air by Class A amplifier stages of relatively small proportions. For example, take the ordinary push-pull high-quality amplifier as a criterion. A pair of KT66s will produce 15 watts, as is well known to all devotees of Williamson. As a Class A amplifier, therefore, these tubes will equally well produce 15 watts of S.S.B., provided only that the frequency is not too high for them. Now with the S.S.B. advantage, such a signal would be equivalent to an A.M. signal with a carrier power of 60 watts. Many amateurs make do quite successfully with less carrier power than this, and a conventional A.M. system, so that it is economical to use a Class A final like this, even if its efficiency cannot be greater than 25%. It means, in effect, that one can put on the air the equivalent of a 60-watt A.M. signal with a power pack no larger than that which is used for a Williamson amplifier. Indeed, if you have one of these amplifiers, you can well make use of its power supply without building another one at all! The advantages of Class A stages all apply, even though the signal is at R.F. instead of at audio.

(1) No driving power is required—only signal voltage—so that the S.S.B. generator can work at as low a power level as we please.

(2) The power supply works at constant current, and so does not need to be well regulated.

(3) Since signal voltage is easy to obtain, the linearity of the amplifier can be improved by using negative feedback, much as in an audio amplifier.

(4) If the tubes you propose to use have tabulated data in the valve handbook for Class A, AB, or B **audio** operation, the operating conditions, such as bias voltage or resistor, and load impedance, can be read off and used just as if the stage were in fact an audio amplifier.

As against these advantages, there are one or two things which may certainly be regarded as practical inconveniences, simply because they make the operating technique different from that of Class C R.F. amplifiers. These things can hardly be classed as disadvantages, though, because there are answers to all of them.

First of all, there is the little matter of tuning indication. A linear amplifier without grid current is not as easy to tune up as a B or C stage, because there is no grid current to use as an indication of correct tuning of the input circuit. Secondly, with no modulation, there is no R.F. output, so that the output circuit cannot be tuned unless a steady modulating signal is present: Third, with a Class A stage, and to some extent with an AB one, it is impossible to use the plate current swing as an indication of maximum output, because there is no plate current swing! Thus, judging the overload point, which is most important with S.S.B. (for the same reasons given earlier for having low distortion) can be difficult. Fourth, correct loading by the aerial is difficult to judge.

All these things can quite easily be overcome. For instance, the first, that of grid tuning indication can be overcome by building in a small V.T. voltmeter of the diode peak-reading variety. If this is done it can be arranged to read positive peaks, and since the maximum allowable positive peak voltage is well known, being a volt or two less than the grid bias in the case of a Class A amplifier, a red mark could be put on the scale to indicate the maximum input swing. The voltmeter can then be used as a working indicator of input level. It can also be used for tuning up the input circuit, since its indication, with a steady audio tone into the S.S.B. generator will show a maximum at correct tuning, just as does a grid-current meter in an ordinary Class C stage.

The second item, tuning of the output tank, can be done in a similar way. A diode rectifier circuit could be permanently installed, as in the case of the grid circuit, and the meter used could be switched from one place to the other; alternatively, no meter need be provided if the station multi-meter can be plugged into jacks in the two diode circuits. The third question, that of judging maximum output voltage before distortion sets in is best done with an oscilloscope, by what is known as the two-tone method. A single tone, when fed into the S.S.B. generator, will produce a single radio frequency, so that if the output is examined on the scope, all that is seen is a band of light, indistinguishable from an unmodulated carrier. But if the two audio tones are fed into the generator simultaneously, the output voltage will fluctuate from zero to maximum amplitude, and will look on the scope rather like an A.M. carrier, having peaks of maximum output separated by smaller amplitudes down to zero. These peaks should look like a sine-wave, although the zeros will not, and with this pattern on the scope it is a simple matter to tell when the stage is in overload, by observing when the peaks start to become flattened out, or otherwise distorted, as the input signal is increased.

This scope pattern is also the best one to use when adjusting the load coupling. The coupling to the output transmission line, or to the aerial direct, is increased, and the input amplitude is advanced until distortion shows on the pattern, this being taken not from the plate circuit of the amplifier, but from across the transmission line itself. The aim is to get the largest possible undistorted signal into the load, and the two adjustments are varied systematically until this is achieved. The stage is then producing its maximum undistorted power output. Another way of doing the job is to set the input excitation control to the maximum allowable level: i.e., so that the tubes are just below the grid current point (unless the stage is a Class B one). Then the load is coupled more tightly until the maximum undistorted output appears across it. The peak-to-peak amplitude that may then be safely taken out is then displayed on the scope, and if this is permanently left across the load, it can be used as an indicator of overload when intermittent speech waveforms are applied to the transmitter.

These techniques may take a little getting used to, but very little practice will make perfect. The most important thing to realize is that a scope and a two-tone audio oscillator (both of which may be very simple devices) are really all that are needed to be sure of putting an excellent S.S.B. signal on the air.

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NOTES ABOUT NEW BOOKS

INTRODUCTION TO DISTRIBUTED AMPLIFICATION

(2nd. Edtn. By Harry Stockman, S.D. Published by S.E.R. Co., 543 Lexington Street, Waltham, Mass., U.S.A.)

Used definitions and symbols are listed introductorily and discussed in the text, which commences with a presentation of Distributed Amplifier principles. Both pentode and paraphase circuits are discussed. Cutoff predictions by bandwidth indexes follow with consideration of the amion-curve area cut-off method. A detailed discussion is then given of constant-k and negative mutual inductance ladder networks with design formulas extended to include the calculation of line inductors. Suitable tubes and means for cascading are considered, and several typical Distributed Amplifier circuits calculated. One chapter is reserved for the discussion of network synthesis of Distributed Amplifiers, listing the three major steps in the synthesis approach. The eighth and last chapter present amplifier specifications and measurements.

A number of apendices has been included to present in concise form the fundamentals upon which the text material is based. Constant-k and m-derived filters and end-sections are discussed, together with tube loading and nmeans for stage coupling. Phase, time-delay and transients, are considered in detail, and the basic concept of poles and zeros introduced. Four hundred and fifty selected literature references complete the presentation.

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HI-FI—FROM MICROPHONE TO EAR

(By G. Slot. Philips Technical Library. Price 17s. 6d. Obtainable from Philips Electrical Industries of N.Z. Ltd., P.O. Box 2097, Wellington.)

This book is written with the object of giving not only practical advice on the leading technical problems encountered, but also of providing as well a complete survey for the non-technical reader of the technique of sound recording and reproduction. As the title suggests, the entire chain from microphone to loudspeaker is discussed and ample attention is paid to all factors, on both the recording and the playback side, which ultimately effect the quality of reproduction or which are of importance when new equipment is bought.

There are chapters devoted to recording and record manufacture and to the principal properties and utilisation of pick-ups, record-players, record-changers, tape recorders, amplifiers and loudspeakers. Due attention has been paid to all queries concerning maintenance and care of records and needles. Simple and inexpensive test methods for evaluating the quality of an installation have been included, while the importance of room acoustics has not been overlooked.

The author, Mr G. Slot, is a well-known lecturer and a regular contributor of technical articles to various wireless magazines.

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BRITISH CAMERAS TO FILM POLAR EXPEDITION

At a time when competition among the world's camera manufacturers is keener than it has ever been, British-made cine cameras have won selection for one of the toughest camera assignments ever—the filming of the Commonwealth Antarctic Expedition's work next year.

British cameras have not been chosen for sentimental or prestige reasons, but because they have already proved themselves under the most rigorous cold-weather conditions.

British G.B.-Bell and Howell 603T "Auto-Loads" were used to record the historic ascent of Mount Everest in 1953. On the strength of this performance, Sir Edmund Hillary used two G.B.-Bell and Howells to film the landing of the advance party at McMurdo Sound early this year. His films were used in the production of the National Film Unit short "Antarctic Prelude", which has been screened in New Zealand.

Sir Edmund has decided to take five of the same type south to cover the work of the main expedition, when he sails for McMurdo Sound this month. He will use them on his trek to set up bases to the South Pole and scientific posts, and then to cover the 100-day ice continent winter hibernation.

The main British expedition under Dr Vivian Fuchs which will cross the Antarctic continent will also use the same type of cameras to cover their side of the story.

The "Auto-Loads" are fitted with special leather-cloth covering, non-freezing lubricants and trigger starts to enable them to be used by heavily mittened hands in sub-zero temperatures.

They are fitted with Taylor Taylor Hobson lenses—the famous British precision lenses that earn Britain a steady flow of dollars every year. It is claimed that eight out of every ten cine cameras used in the United States—including the film capital of Hollywood—are fitted with British-made Taylor Taylor Hobson lenses.

Cameras used by the members of the Expedition on their great treks will be of 16 mm size—35 mm cameras would be too bulky to be carried by men whose loads will have to be balanced to the last ounce. The quality of the 16 mm film is such that the negatives can be blown up to full 35 mm size for screening.

The films taken on the expedition will be used to make up a full-length 35 mm documentary for world-wide release some time in 1958.

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RECORD TALK

by JOHN GRAY

Here, as promised, and taken mostly from the latest available lists, are some recommendations to those who want to give records as presents this Christmas.

For the Teenager: This is mostly a case of being up to date with the latest, and by the time these notes are published it is possible that the tunes I mention will have been superseded by others not yet off the presses. Not all the youngsters will go for Elvis Presley, but those who do may be advised that his latest (HMV HR or 7MM 10258) is "I Forgot to Remember to Forget" backed by "Mystery Train". Nat King Cole is, to say the least, "cool" in comparison, and the coupling of "Dinner for One, Please James" and "Almost Like Being in Love" (Capitol CP502) is a really good sample of his easy style. One of the funniest, if rather horrific, of the newer discs is a little number called "Transfusion" sung, if that is the word, by a self-confessed "hot rod" fiend called Nervous Norvus, whose activities, as here recounted, result in smash-up after smash-up and transfusion after transfusion. Like "Black Denim Trousers" and "Chicken", this item contains a moral to be learned, not an example to be followed, and I should be doing our teenagers an injustice were I to suggest they would not heed the warning implicit in such items (London NZL116). Others they will like are Alan Dale's ditty "The Birds and the Bees" (Coral CS1064), Joe "Fingers" Carr's treatment of the catchy "Portuguese Washerwomen" and "Lucky Pierre" (Capitol 3418) and, in more sentimental mood, the coupling of "Dreamer" and "I only Know I Love You" by the Four Aces on Festival SP45-1072.

For the Children: There is not really very much. Woody Woodpecker, perhaps, whose latest effort concerns an adventure with a "Truth Tonic" (Capitol CAS3211) or another of Don Wilson's well told stories, "The Little Engine that Laughed" (CAS3196) which is nicely produced and will not fail to entertain. They should also enjoy "Christmas Time with Ronnie Ronalde" (Columbia DB3689) on which the favourite seasonal tunes are very pleasantly done, and in less serious mood there is Stan Freberg's "Nuttin' for Christmas" which points a moral as well as being vastly amusing (Capitol 3280).

For Mother: "The Snow Goose" was a wartime release, in what we should now consider the cumbersome form of three shellac discs, and it featured a very touching story, beautifully narrated by Herbert Marshall and Joan Lorring, with a musical background supplied by Victor Young. It caught people's fancy and was widely popular, but the records were soon unprocurable and the piece became little more than a memory. Many will be delighted to know of its unexpected reappearance, this time on a ten-inch LP (Festival FR10-1099) and it ranks high on the list of desirable Christmas presents.

For Father (and see also the following paragraph): I can imagine nothing to please him more than a record by Peter Dawson—on the occasion of the veteran singer's last tour here, more than one critic remarked on the large proportion of men in the audience. But his 78s are hard to come by nowadays, and he does not seem to be represented on LP, so the appearance of a 45 extended play disc (HMV 7EG8157) is more than usually welcome. This is no revival, either, but a quite recent recording by the singer whose career has spanned that of the gramophone itself, for he first sang into an old acoustic horn machine at the turn of the century and he has survived into the three-speed age. Listening to this disc, made with the London Symphony Orchestra under another Australian, Charles MacKerras, one cannot deny that this is the singing of an old man. The fact that Peter Dawson can still sing, however, is evidence of and tribute to the methods of a generation that turned out real singers. This is perhaps not the place for a discussion on whether some of today's vocal phenomena will be capable, when well into their seventies, of such singing as the grand old man of the gramophone gives us here. The items are the "Mandalay Scena", a pot-pourri of the best known settings of Kipling's poem, and the delightful Australian ballad "Clancy of the Overflow". The disc is worth buying, and not just for sentimental reasons.

For the football fan who, as far as I know, has never been catered for on record, at least not quite in this way, there is a ten-inch Parlophone LP (PMDM 6003) of Winston McCarthy's "Highlights of the Four Tests and the N.Z. Universities' Game." Taken from tapes of the original broadcasts and well edited by Stan Dallas, this fulfils a useful function and the record has already been in strong demand. It gives us the comparatively rare experience of a recording fulfilling a documentary role, and has its place as a souvenir of New Zealand's greatest sporting experience of the last few years.

For the jazz fan who cannot afford to spend too much at one time, the Clef or Esquire extended play 45 series is just what is wanted. Excellent samples are the Dizzy Gillespie-Stan Getz coupling of "Talk of the Town" and "It Don't Mean a Thing" (EPN-4), the dazzling guitar playing of Tal Farlow on EPN-84, or an Oscar Peterson disc of George Gerschwin favourites (EP-103). For those who can manage the price of an LP there are several excellent items on Esquire, done by such up-to-date combinations as the Thelonious Monk Quintet (20-039), Gerry Mulligan's All Stars (20-032) and the Art Farnor Quartet (20-051). Also, Esquire does not neglect such old-timers as Sidney Bechet, who goes to town with his New Orleans Feetwarmers on 20-058.

For the Glenn Miller fan, who is presumably an individual not over-worried by financial considerations, comes another substantial package of five 12-inch LPs in an HMV album, entitled "Glenn Miller Limited Edition, Volume 2". Numbers are not quoted, as the package is sold only as a unit. This is a volumnious selection of numbers taken from radio broadcasts made by the Miller orchestra between 1938 and 1942. The recording companies have rediscovered Glenn Miller with a vengeance, and it is hard to think of a similar case of posthumous fame in the record world. If I am allowed the comparison, I should say that his beatification, which began at the time of his film biography, seems now about to develop into canonization. Still, this huge issue provides a chapter in the history of the American dance band, for among the players who began their careers in Glenn Miller's orchestra are quite a number who now lead, or have led, famous ensembles of their own (Ray Anthony, Tex Beneke, Billy May).

For that vast assemblage who "know what they like"—well the choice is really endless. Not for them the hectic atmosphere of jazz or the rarified air of Palestrina, but good, solid melody all the way. Culling the latest lists, we should be able to spot numerous items to suit this class of music lover. A selection of Rudolf Friml's musical comedy tunes, for example, can be had as played on the piano by the composer himself (Festival CF10-524). Dimitri Tiomkin, composer of the music for a dozen or more memorable films, conducts his orchestra in leading themes from them on CFR10-753. The joyous music of "Can Can" is recorded by the original stage cast (Capitol S452) and in even livelier vein there is an album of sambas from the irrepressible Edmundo Ros (Decca LK4110). Four melodious Chopin waltzes are enchantingly played by Dinu Lipatti (Columbia SEB3508), or you can choose a complete set of the Brahms Hungarian Dances, as played by the Oklahoma City Symphony Orchestra under Victor Alessandro on a twelve-inch Allegro (ALX3006). For those who like Viennese waltzes and polkas there are two excellent records. First, a Leslie Bridgewater disc featuring some of the lesser known pieces by the Strauss family: this is for those who enjoy these pieces played by a smallish orchestra rather than a full-scale symphonic one (Delyse EK2123). The other is a condensation of the Johann Strauss operetta "Die Fledermaus", conveniently boiled down to the duration of a ten-inch disc (HMV DLP1120). All the highlights are here, though of course considerably abridged, but the whole makes a delightful and melodious half hour, and the performance by leading German singers with the chorus and orchestra of the Hamburg Radio is certain to give real pleasure. Everybody likes "Fledermaus", but not everybody feels able to afford the complete version on two twelve-inch LPs, so this new abridgement fills, as we say, "a long felt want".

For the Mozart fan the choice could well be bewildering since so much has poured out in the past year or so, but it happens that something quite exceptional has turned up to simplify one's choice. Philips, in their new "Coronet" series (the label under which they will in future distribute American Columbia records) are offering a two-record set entitled "The Birth of a Performance" (KLC 512-3). Three sides are taken up with Bruno Walter's studio rehearsals for a recording of Mozart's "Linz" symphony, the fourth side gives the finished result. We are assured that the rehearsals were quite spontaneous: a microphone was switched on and neither conductor nor players were aware of the fact. This may be deduced from a subsequent incident. One quite well known instrumentalist from the orchestra, who is addressed by Dr. Walter and mentioned twice by name during the course of the rehearsal, protested strongly against the release of the discs, claiming they give the impression that the conductor was telling him how to play his instrument! In any case, the result is endlessly fascinating and could settle once and for all the old question as to whether the conductor is really necessary and what exactly he does. Here we have the great symphony being built up bar by bar before our very ears, our

eyes too, for the Coronet album includes a miniature score. It is a moving experience to hear the wonderful old man rehearsing patiently but firmly and, with a real old world courtesy, imparting to the orchestra and to us, the fruits of a lifetime study of Mozart's music.

For the connoisseur there is a record which preserves the playing of Simon Barere, one of the great pianists of his time, who died shortly after he had visited New Zealand, some years ago. His older recordings have long been out of print and this newer one, in the W and G Selected Releases, features an extensive recital of Chopin and Liszt pieces. I lack exact details, but this may be the disc which was issued of some actual performances he gave in Carnegie Hall (WG-PCR-168). Another pianist well known in this part of the world is Solomon. He is at present engaged in recording a complete set of Beethoven sonatas, but on this occasion he turns to Brahms and gives us that composer's powerful Sonata in F minor (HMV ALP1358), a work which he played on the occasion of his last visit to this country. On another record we go back to Liszt as played by the famous Hungarian pianist Edith Farnadi, a very well known figure in Central Europe whose recordings have brought her much wider recognition. Her version of the great Sonata in B minor (Westminster WL5266) has been hailed as one of the best, and the record includes also her performances of the Mephisto Waltz and the Valse Impromptu. Lovers of fine singing will be interested in the late Elisabeth Schumann's record of songs by Mendelssohn and Franz, released on Allegro ALY51. It was one of her last reordings, made shortly before her death, and if the overall sound is not of the best by today's standards, it is adequately representative of the great singer, whose voice was ideally suited by these delicate songs. It fills a gap, also, because the songs of both these composers are not otherwise represented on disc to any great extent, and if they are ultimately of minor importance there is no denying their freshness and charm. The accompanist here is George Schick.

For the opera lover there are few works more likely to give all round pleasure than Verdi's "Rigoletto". The story has a strength not found in all those of its period, the music is Verdi at his most characteristic, and there is a full measure of great solos and ensembles. With four complete versions to choose from, it is certainly adequately represented. The two latest ones are the Columbia La Scala recording (33CX 1324-6 with one of the discs single-sided) and the Cetra version (three discs in Set C 1247). Financially the choice is easy because the Columbia costs rather less. There is a tremendous performance of the title role by Tito Gobbi and Maria Callas is at her best in the part of Gilda, which is usually sung by a soprano with a much lighter voice. Her vocalising in "Caro nome" is breathtaking and in the course of the reprise at the end she produces a real trill, an accomplishment which, unfortunately, cannot be taken for granted nowadays. It's impossible to deny, however, that her rival Pagliughi in the Cetra set has exactly the "Gilda" type of voice. She is no longer young but this hardly counts, for her lovely singing is as assured as ever. Older opera goers will recall her singing of this part when she was here with Williamson's "Imperial Grand Opera" in the early nineteen thirties; she also starred in the early electrical set of HMV's and thus is no stranger to the part. Her Rigoletto is the excellent Giuseppe Taddei, and I think that Cetra's Tagliavini, in the tenor role, scores over Giuseppe di Stefano on Columbia, provided you prefer elegance to vigour in this part. The orchestral performance is slightly more exciting under Serafin in the Columbia. Most of us would be happy with either version.

Finally, for those who cannot make up their minds what to buy, we shall mention just a few "middle of the road" releases which may fill the bill in one respect or another. Julius Katchen's performance of the Rhapsody in Blue, for example, should please almost anybody. Already procurable on the same disc as the composer's piano concerto, it is now made available on its own (Decca LF1222). It would be hard to find a greater favourite than the "Peer Gynt" Suite No. 1 of Greig, and impossible to find a more economical presentation of it than that on HMV 7EPM 7022, for, believe it or not, the whole of it has been accommodated on one extended play 45, and the playing of the Boston Promenade Orchestra is brilliantly recorded. This is the sort of inexpensive disc with which young people could begin a collection of worthwhile music. Ballet fans will welcome the Sadler Wells Ballet Silver Jubilee record (HMV CLP1070) which contains short excerpts from a dozen works especially created for this famous company. Very few of them have been seen on the stage here, if any, but the music is attractive and some of it is familiar in other versions. For those who wish to examine the truth of the Caruso legend, HMV have issued a long playing collection of some of his famous operatic solos (MALP 6002) and have done similarly for Paul Robeson (ODLP 7507).

And, now A RECORD CHRISTMAS FOR EVERYONE!

LETTERS TO THE EDITOR

TRAINING OF SERVICEMEN

Sir.—I have had fairly wide experience in the R.N.Z.A.F., N.Z.B.S., and for the last few years as a radio serviceman—i.e., radio service engineer, and would like to comment on your editorial regarding Dr B. C. Lees's remarks in your September issue.

As I interpret your remarks, a radio serviceman is in the lowest class in the field, calling for small mental capacity. The position in New Zealand may well be as you say, unfortunately for the public.

When a student, I was well above average in most subjects and R.N.Z.A.F. exams., and passed the Technical Certificate in Broadcasting in 1945.

The reason I have chosen servicing is because I like it, and find that **good** servicing demands all my knowledge and ingenuity, and as a job appeals much more than many where one is called a **technician,** but does not do (and is, in the main, incapable of) technical work demanding initiative.

I maintain that good radio servicing demands highly specialized knowledge and efficiency. On the financial side, we have the position that the radio serviceman is amongst the poorest paid in any skilled industry. Many employers have staff on a minimum wage and not even qualified, and a minimum of equipment and tools—making this inefficiency pay by high service charges.

And there the position will remain unless radical changes are enforced in servicing standards. Which do you support? Raising the standard, or does business profit come first? Both should be able to progress together.

Now, my job shortly will be as a waterfront worker! Until I have sufficient capital to commence my own business.—I am, Sir,

W. L. KALES (R.S.345).

NEWS FROM GOVERNMENT DEPARTMENTS

POST OFFICE NEWSBRIEFS

The New Zealand Post Office has announced that overseas radio-telephone services have been extended to Columbia in South America and to the Lebanon. These two additions make a total of 53 countries receiving radio-telephone communication from New Zealand, and mark another step towards a more comprehensive radio-telephone communication between the Dominion and the rest of the world.

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One of the little known activities of the Post Office consists in regulating and controlling New Zealand's rapidly expanding radio services. Quite apart from the normal broadcasting stations, there are 5,566 radio stations which provide utility services for the public and industry, as well as emergency services and safety devices for the population as a whole.

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Over the last year New Zealand has moved into fourth place on the list of the world's most telephone-conscious countries. This places N.Z. slightly ahead of Switzerland, a country which has had almost similar telephone development each year for the past ten years. At present there are 23.29 telephones to every hundred people in the Dominion.

ELECTRICAL AND TRADE SECTION

LIGHTING NOTES

(Adapted from "The Practical Electrician's Pocket Book, 1956)

PRINCIPLES

Good lighting is necessary, not only for seeing, but for health, cleanliness, cheerfulness, and aesthetically pleasing surroundings. Although detailed requirements vary with the nature of the task and place, there are certain essentials of good lighting that must always be considered.

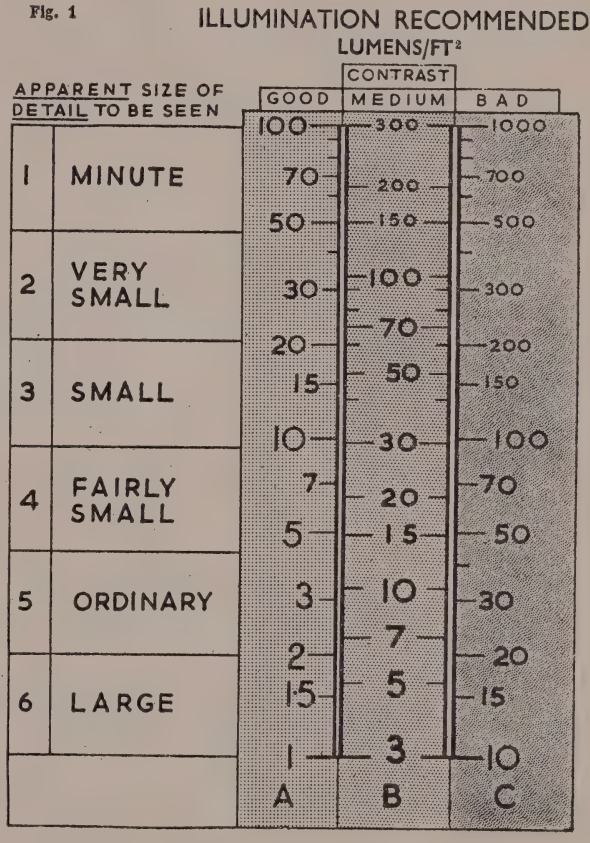
Amount of Illumination

Although many tasks can be carried out under poor lighting, efficiency of working is low and fatigue and accidents result. Correct illumination depends on various factors, viz.: size of object, its reflection factor, brightness contrast between object and background, time available for seeing, and age of operator.

The recognized standards in Britain are the Illuminating Engineering Society's Recommended Values of Illumination (see summary given in Table 1). These are based upon a standard of performance which is 90 per cent. of that possible with ideal lighting and represent a reasonable compromise between efficiency and economy.

If there is no recommendation for a particular task, an estimate can be made with the aid of the following chart (Fig. 1). First decide on the apparent size of the detail to be seen and the viewing distance. Opposite each "size" scale appears a range of illumination values in each of the three "contrast" columns. By selecting the contrast appropriate to the conditions of the particular task, an illumination value can be selected

Fig. 1



Quality of illumination, as distinct from quantity, is dependent upon the following:

(a) Distribution.—Installations should be designed so that vision is aided by suitable diffusion and direction of light. Strongly directional light will tend to produce hard shadows which can give rise to accidents, while highly diffused light may give insufficient contrast of light and shade, thus failing to reveal form. The general distribution should also be such as to avoid dark corners and areas; if ceiling and upper walls are in comparative shadow, the effect is depressing.

(b) Glare.—For a lighting scheme to be satisfactory, glare in all its forms must be at minimum.

"Disability glare," which gives rise to a reduction in ability to see, is due to excessive light falling on the eye, either directly from a light source or indirectly from secondary reflections. Diffusing fittings or control by spill shields or louvres reduce the light directed towards the observer and at the same time, perhaps, improve distribution. Disability glare can be reduced if the small concentrated area of vision is increased in brightness or the mounting height of the source is raised.

"Discomfort glare," which arises from the presence of excessive contrasts in brightness in the field of view, results in visual discomfort which, due to its subjective character, cannot easily be evaluated. Contributory factors are high brightness of sources, large projected areas of sources, unsuitable brightness of background and surroundings, and sources too near to the line of sight.

Glare may be combated by considering the various brightness ratios within the field of view. For instance, the ratio between the average brightness of the task and that of the adjacent background should not exceed 3 to 1. The fittings themselves should be limited in brightness and area and should tend to merge into the background which itself should not be less than one-tenth of the brightness of the task. Care should be taken to avoid the presence of any polished surfaces giving undesirable specular reflections.

Illuminating Engineering Society's recommendations in respect of brightness of fittings are shown in Table 2.

Table 2.—Maximum Permissible Values of Average Brightness (candles per sq. inch) for substantially uniformly bright luminaires in light surroundings and within an angle of the eye (5 ft. above the floor) of 110 degrees from the perpendicular to the floor.

Planned average horizontal illumination (1 m./ft.2)	Projected area of luminaire					
	More than 200 sq.in.			Less than 200 sq.in.		
	Mounting height above floor					
	Less than 8 ft.	8 to 16 ft.	Over 16 ft.	Less than 8 ft.	8 to 16 ft.	Over 16 ft.
Less than 15	1	2	3	2	4	7
15 to 50	2	4	7	3	6	10
Over 50	3	6	10	5	7	10

(c) Colour of Light.—The appearance of an object is essentially dependent upon the spectral quality of the light. Most artificial light sources cause some distortion compared with natural daylight. If there is a fair proportion of all wavelengths present in lighting, there is little cause for complaint, although personal preference may influence decisions, particularly as so many types of "white" fluorescent lamps are available.

For commercial purposes where artificial light is required to supplement natural light, sources having a spectral composition akin to that of daylight are recommended. Uncorrected mercury vapour and sodium vapour discharge lamps should not be used for general lighting due to the high distortion produced.

(d) Steadiness of Light.—Lamps that exhibit flicker or undergo abrupt changes in light output interfere with comfort and safety. Such phenomena, usually associated with defective discharge lamps, must be avoided. If stroboscopic effects are troublesome, special steps can be taken to minimize them.

TABLE 1 —SCHEDULE OF RECOMMENDED VALUES

Interior or Occupation	Foot-candles
GENERAL	
Corridors and Stairways	7
DENTISTS' SURGERIES (chair)	70
Waiting Rooms	7
HOMES: Bathrooms (general)	5
Kitchens (cookers, sinks and tables)	7
Reading, sustained	15
Living Rooms	7
HOSPITALS: Operating Rooms	30
Operating Tables	300
Waiting Rooms	7
HOTELS: Dining Rooms and Lounges	
INDOOR RECREATIONS: Bowling on alley and runway	15
On pins	20
Billiards general	3
on table	27
Skating rink	0
LIBRARY: Reading rooms (general (on books)	7
	15
Book room	7
OFFICE BUILDINGS: General office	20
Enquiry Rooms, waiting rooms, etc.	7
PUBLIC BUILDINGS: Churches (Altars, Chancels)	7
Churches (Naves)	5
Libraries (Reading Rooms)	7
,, (Reading Tables)	15
SCHOOLS: Sewing, Drawing and Art rooms	20
Day classrooms, Laboratories	20
Gymnasium, Lecture Theatre	10
SHOPS: Interiors	10 and upwards
Windows	100 and upwards
INDUSTRIAL	
ASSEMBLY: Very small	100
Small	50
Medium	20
Ordinary	10
Large	7
COLLIERIES: Picking belts	20
Machinery controls	7
DRAWING OFFICE: General	10
On Boards	30
FOUNDRIES: Fine core making, fine moulding	20
Cupola charging, cleaning, pouring, shaking out and tumbling	7
Rough core making and rough moulding and casting	

Interior or Occupation	Foot-Candles
GARAGES: Repairs	20
General Maintenance	
INSPECTION: Minute	200
Very small	100
Small	50
Fairly small	20
Ordinary	10
LAUNDRIES AND DRY CLEANERS	
Sorting, checking and ironing	15
Washing	7
MACHINE AND FITTING SHOPS: Ordinary Bench Machine work	20
Medium do., Ordinary Automatic Machines	20
Fine do., Fine Automatic Machines Medium Grinding, Fine Buffing and Polishing	50
Very Fine do., Fine Grinding	10
PACKING	10
PRINTING: Typesetting by hand of small type (up to 6 point), setting tabular and mathematical matter	30
Imposing, lino-, mono-, and hand typesetting from good copy, electrotyping, lithographing, proof reading, and colour printing	20
Casting, matrixing, miscellaneous machines and presses	10
SHEET METAL WORKS: Bench Work, pressing, punching, shearing, stamping, spinning and folding	20
WELDING, SOLDERING AND CONTACT WELDING: Fairly small soldering and contact welding	20
Ordinary	15
Flame Welding and Brazing	7
WOOD WORKING: Rough Sawing and Bench Work	15
Sizing, Planing, Rough Sanding, Medium Bench Work, Glueing, Veneering	15
Fine Bench and Machine Work, Fine Sanding and Finishing	20

MISSING AND STOLEN RADIOS

Ngongotaha:
Clipper, model CR55, auto radio, serial No. 67935.

Palmerston North:
Bell 5-valve radio, serial No. 6536; white bakelite cabinet.

Wellington:
Bell 5-valve, mantel model radio, serial No. 30996; ivory coloured plastic cabinet.

Pacemaker AC/DC portable, serial No. 54-807; bright red plastic cabinet with white plastic carrying handle.
Philco 4-valve radio, serial No. W2116-63249; white plastic cabinet.

Philips 5-valve, broadcast receiver, model 356, serial No. 901099, royalty No. 104033; cream cabinet.

Christchurch:
Philips 5-valve portable radio, model 546, serial No. 85985; maroon plastic cabinet 10 in. x 8 in., with curved handle on top, four clear plastic tuning knobs and clear plastic dial. Neon magic eye in front and three batteries inside case.

Colombus 5-valve, dual wave, mantel model radio. Brown varnished wooden cabinet 18 in. x 9 in. x 11 in., with rounded corners and top edge, oblong-shaped dial with red pointer, 4 tuning knobs, speaker on right covered with square of brown fabric with wooden bar across centre. Short length of brown flex attached with 3-pin plug.

Dunedin:
Philco 4-valve, clock radio, model 804, serial No. 74684: limed oak cabinet 15 in. x 6 in. with clock on left hand side and radio dial on right, three white tuning knobs, speaker grille in between clock and radio dials.

CLASSIFIED ADVERTISEMENTS

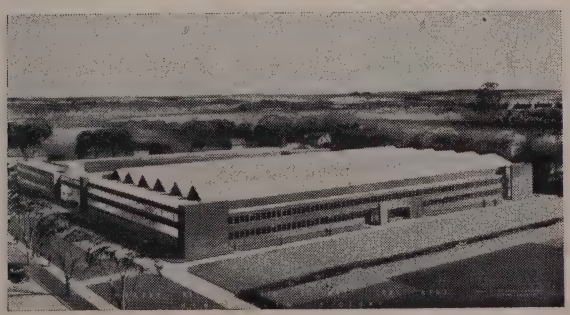
Rates 4d. per word, minimum charge 3s. Deadline date 1st of month preceding publication.

TRADE WINDS

NEW ZEALAND ELECTRICAL RETAILER VISITS MORPHY-RICHARDS IN ENGLAND

Pictured below are Mr D. A. Morrison, of Wanganui (right), with Mr Grundy, of the Australian Anthony Horden Store, outside the Morphy-Richards factory in Kent.

Principal of D. A. Morrison & Co. Ltd., electrical retailers of Wanganui, Mr D. A. Morrison recently spent a holiday of some months in the United Kingdom, during which time he visited several of the British manufacturers whose goods he distributes in his store.



The new Morphy-Richards factory at St. Mary Cray, Kent, where automatic irons are manufactured.

At the invitation of Morphy-Richards Ltd., well-known manufacturers of electric irons and toasters, he visited their large new factory at St. Mary Cray, Kent. Here he watched the Morphy-Richards process from the raw material to the finished product, with automation playing an important part in the manufacture. The total value of the production of Morphy-Richards electric irons alone is £50,000 a week. Highlight for Mr Morrison was the sight of a large consignment of electric irons being packed for the New Zealand market, with special guarantee cards valid only in this country.

Agreeably surprised with the keenness displayed by the Morphy-Richards staff in their desire to welcome overseas visitors to their factory, Mr Morrison was most impressed with the methods and efficiency of this highly successful organization.

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NAGARD LTD., OF ENGLAND, NOW REPRESENTED IN NEW ZEALAND BY ELECTRONIC CONTROLS & APPLIANCES LTD.

Nagard Ltd., of Surrey, England, manufacturers of electronic equipment including pulse generators, oscilloscopes, etc., are now represented in New Zealand by Messrs Electronic Controls & Appliances Ltd., P.O. Box 252, Auckland.

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RADIO RECEIVERS IN NEW ZEALAND

It is estimated that there are now almost 1,000,000 radio receivers in New Zealand. This means that there is now a radio receiver to almost every two people in this country. During the past seven years the number of radio licences has risen from 432,000 to 517,000, and there was an increase of 3,500 during the 12 months ended on 31st March.

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POPULAR RECORDS RENTAL SERVICE

Latest innovation at the Wellington Central Public Library is the inauguration of a long-playing record hire service.

Borrowers may select from the library's stock of more than 800 records. The latter are issued from the desk in the library's main reference room, and a comprehensive catalogue is available for one shilling. Each borrower can take up to three records at a time (or more in the case of sets, such as a four-disc opera set). Charges are 2s. 6d. a disc and 2s. for each additional disc of a set, for a fortnight's hire.

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PYE FISH FINDER NOW IN NEW ZEALAND

The Pye Fish Finder is now available on the New Zealand market after receiving an excellent reception in England where over 30 have been installed in British fishing vessels with excellent results. They have been fitted in large Iceland trawlers and intermediate North Sea Drifters and the majority of orders are now coming from the small Scottish fishing ports, such as Buckie, Lossiemouth, Fraserburgh, and Peterhead, for fitting in small 45 ft. motor fishing boats (Seine netters), who fish near base in the Moray Firth. Even though these are very small boats with tiny wheel-houses, the owners, after the first initial successes of the Pye Fish Finder in this area cannot afford to be without this new invention.

Until the advent of this Fish Finder, there had been no marked technical improvement in echosounder design since they

were first invented in 1927. All competitive echo sounders, whether of the indicator, recording or cathode ray tube type, use the old-fashioned method of transmission known as "Capacitor Discharge Shock Exciter", whereby a powerful condenser discharge causes the magnetostriction oscillator or transducer to act as if it had been "hit with a hammer" and send out ultra-sonic waves on the frequency to which the transducer was designed. This means that (a) the pulse repetition rate is slow and fixed within certain limits, (b) to carry the quick and powerful discharge, the transducers must be close to the transmitter and (c) the length of the pulse is quite large. All these points are limitations so far as (i) maximum efficiency, particularly in bad weather (ii) placing transducers in best position and (iii) sensitivity near the bottom of the sea, are concerned.

Three years ago ,Pye engineers, assisted by French engineers, started work to improve upon the known weaknesses of existing techniques. The problem set was how to (a) give a pulse repetition rate which is easily variable to optimum value in any given depth; (b) fit transducers in the net in addition to in the ship and (c) give a very short pulse length for increased sensitivity, as by so doing all the inherent disadvantages would be overcome. After really exhaustive laboratory tests, followed by prolonged sea-trials in all known types of fishing vessels (French and British), it is considered that the Pye Fish Finder has completely solved most of the shortcomings of every other known echosounder. The use of a pulse CW transmitter (not unlike in basic design a Radar transmitter), has achieved (a) a variable PRR up to a maximum of 15 per second (most conventional echo sounders use about 1 per second), (b) the possibility of placing the transducers up to 1,000 yards away from the transmitter (becauses there are no losses in the cable) and (c) a pulse length of 0.5 M/seconds (some conventional echometers use 20 M/seconds). This all means that Pye has the most accurate depth indicator and Fish Finder ever before produced.

Future developments can be added to present Pye Fish Finders without rendering the existing equipment obsolete. Two principal new developments are:

(a) "Floating Trawl Attachment", a further set of transducers fitted on the net to indicate depth of net and size of opening of trawl. (N.B.—This can only be done with the Pulse CW technique).

(b) "Fish Counter", an attachment to indicate density of shoal and to estimate the amount of catch.

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RADIO CONTROL FOR IRANIAN OIL PIPELINE

Pictured above is a Marconi engineer standing on the site of a VHF multi-channel radio station at Kuh-i-Sofid, 16 miles from Arak in Iran. Not fara away the temperature can exceed 120 degrees F., in the shade.

In all, 84 Marconi multi-channel equipments Type HM.181, together with a considerable quantity of telephone carrier equipment, are being installed along the National Iranian Oil Company's new 600-mile oil pipeline from Abadan to Teheran.

The four principal stations along the route are to be sited at Abadan, Ahwaz, Azna, and Teheran, switchboards being provided at all these, with six circuits connecting the stations. All the other pumping stations along the line will have radio-telephonic communication facilities with one or other of the main stations. In addition, a teleprinter circuit common to all pumping stations will be incorporated. In due course, available speech channels will be increased to eleven, while an additional twelve can be provided should occasion arise.

The majority of the stations along the route will be unattended, each unattended station being completely self-contained, with its own diesel-electric power supply.

In the event of a fault developing on either the radio equipment or the power supply, spare plant will be brought into operation automatically and a notification of the fault sent over the radio system to the nearest manned station. Such a station would need to be visited only once a month for the purpose of replenishing the oil-fuel.

Marconi engineers who carried out a detailed survey of the Abadan-Teheran route during the early months of this year, reported that climatic and geographic conditions were among the toughest encountered by a Marconi survey team anywhere in the world. Blizzards and gales were frequent. Temperatures along the pipeline can range from over 120 degrees F. in the shade to —20 degrees F. The terrain over the centre section is particularly rugged and inhospitable—one of the selected sites is about 8,000 feet above sea level.

Point-to-point telecommunications in the higher frequency bands have grown fast in recent years. Some indication of the

scale of this Company's activities in this field is contained in the fact that the total telephone channel miles of the Marconi radio multi-channel systems completed to date would go ten times round the earth.

BACK NUMBERS OF "R. & E. R."

Back numbers are available from:

S.O.S. Radio Ltd., 283, Queen Street, Auckland.

S.O.S. Radio Ltd., 1 Ward Street, Hamilton.

Webb's Radios Ltd., 11 Wellesley St. E., Auckland.

Tricity House Ltd., 209 Manchester St., Christchurch.

Ken's Ltd., 142-144 Stuart Street, Dunedin.

Fear's Radio and Cycle Co. Ltd., 31 Willis Street, Wellington.

The Radio Service Co., 83 Guyton Street, Wanganui.

Technical Book and Magazine Co., 295-299 Swanson Street, Melbourne, Australia.

Plessey

RADIO COMPONENTS

Variable Capacitors, Air and Compression Trimmers, Drives and Couplings, Vibrators, Chokes and Transformers, I.F. Transformers, Wavechange and Toggle Switches, Valve holders and Pilot Lamp-holders, Loudspeakers, Iron Dust Cores and Formers, Potentiometers, Cascap and Caslam Capacitors, Electrolytic Capacitors.

New Zealand Representative:

WILLIAM J. BLACKWELL

P.O. Box 1622. Auckland

FINANCIAL TRENDS IN THE RADIO INDUSTRY

(By Our Financial Correspondent)

The year 1956 has seen a general downturn in business profits, in which the radio and electrical industry has shared.

The Government's credit squeeze was designed to check inflation and restore overseas reserves by reducing spending.

It was plain from the start that, to the extent that it succeeded, aggregate business turnovers must fall, and with them, in the first instance, profits.

The radio and electrical industry was specially vulnerable, not only to the general effects of a reduction in spending, but also to the specific effects of hire-purchase restrictions.

In the process of readjustment from boom conditions someone was bound to get hurt. There have been casualties and there may be more. But, though current trends make caution necessary, they do not justify lack of confidence in the future.

For an objective, long-term view of the squeeze one could hardly do better than quote Mr A. M. Seaman, chairman of George Court & Sons Ltd., a company which has itself suffered from a substantially reduced volume of hire-purchase trading in its home appliance department.

In his annual address to shareholders, Mr Seaman said that the steps taken under the Reserve Bank's policy of financial control were, on the whole, justified and necessary for the maintenance of the financial wellbeing of the community. In the long run, therefore, the company should benefit rather than suffer.

The chairman of Wiseman's Holdings Ltd. also took a balanced view in his reference to a falling-off of sales of home appliances "to what is considered more normal trading."

Probably the most notable example of the immediate effects of the credit squeeze was provided by the accounts of Ultimate-Ekco (N.Z.) Co. Ltd., formerly Radio (1936) Ltd.

For the year to 30th June, the company's net profit fell by more than half, from the 1955 record of £23,451 to £11,387.

The directors said that turnover in radios was quite good, but there was a fairly sharp decline in sales of electrical household utility lines. This was due mainly to the credit squeeze, partly to the over-importation of competitive goods.

Overseas efficiency experts were working in the factory and would continue to do so till no further gains in efficiency or reduction in costs were possible.

The net profit of £11,925 represented an earning rate of 11.4 per cent. on capital of £100,000, or 6.7 per cent. on shareholders' funds of £178,661. Earning rate the previous year was 33.5 per cent. on capital of £70,000, or 17.2 per cent. on shareholders' funds of £137,274. During the year, capital was increased by an issue of 60,000 10s. shares at a premium of 2s. 6d. to E. K. Cole Ltd., England.

Dividend was reduced from 10 per cent. to 7½ per cent., but, £7,500, required £500 more than the previous year because of the increase in capital.

Bank overdraft rose by £7,511 to £85,015; stocks by £17,528 to £197,056.

In the course of the year, two prominent companies in the industry experienced serious troubles arising, at least mainly, from causes other than the credit squeeze.

First came the decision of Westco Products Ltd. to go into voluntary liquidation following losses of £40,420 in 1954 and £923 in 1955.

The company's difficulties began when a Dutch-made unit in its refrigerators revealed a serious fault in operation. Westco was in no way to blame. The Dutch manufacturers accepted a claim for £38,000 compensation, but were forced into liquidation before they could pay. Then, strong competition from imports led a Westco customer to repudiate a contract to take 150 washing machines a month. With intensification of the credit squeeze, the market for radios fell away, and liquidation became inevitable.

The company's deficiency was estimated at £11,074. Paid capital was £73,880 in 54,675 ordinary and 19,205 cumulative redeemable preference shares of £1 each.

Accounts of Radio Corporation of New Zealand Ltd. for the year to 31st December, 1955, appeared in August, and revealed a net loss of £61,801, against a profit of £6,834 the previous year. After adding to the net loss £4,002, the amount of the dividend declared for 1954 but not yet paid, and subtracting £1,276 over-provided for tax in previous years, the company carried forward a debit balance of £39,211, against a credit balance of £25,316 the previous year. The consolidated balance sheet showed that shareholders' funds had been reduced from £151,327 to £88,148. Paid capital is £85,043.

The chairman, in his report, said that, following differences of opinion, an extraordinary meeting was held just before the balance date and some new directors were appointed as a result of a report by a committee of shareholders. A new general manager had been appointed and all the operations of the company were being reorganized. The directors felt that, while it would take a considerable time, the company could be restored to its former sound and profitable position.

Turnover was down by about 11 per cent. The net loss was brought about principally by a reduction in the value of stock in hand. Investigation had shown that little, if any, provision for obsolescence and deterioration had been made over many years. Final figures for the subsidiary, Radio Centre Ltd., whose year ended 30th June, were not available. Stock of the subsidiary was being revalued and the position would be reflected in the next annual accounts.

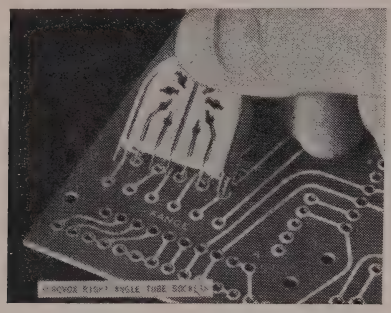
Turnbull & Jones's balance sheet brought some brightness into a rather gloomy atmosphere. Net profit was £2,256 up at £45,917, and ordinary dividend was raised from 8 to 10 per cent.

Preference dividend of 5 per cent. on £100,000 took £5,000; ordinary dividend of 10 per cent. on £175,000 took £17,500. Total dividend requirement of £22,500 was covered more than twice over. Profit

(Concluded on page 50)

LATEST OVERSEAS DEVELOPMENTS

RIGHT ANGLE TUBE SOCKETS FOR PRINTED WIRING



Mounting tubes parallel to printed-wiring boards by means of right-angle tube sockets, is the latest space-saving contribution of the Pacific Coast Division of Aerovox Corporation. .. .. ..

Aerovox Right-Angle Tube Sockets provide marked reduction in height and depth of printed-wiring assemblies. The sockets are equally adaptable to hand or machine-insertion methods. Terminals are of adequate length to slip into printed-wiring holes and be dip soldered. Silver-plated contacts are engineered to provide non-fatiguing contact pressure with suitable insertion and withdrawal pressures. Metal parts and mounting hardware are plated to meet salt-spray test specifications. Designed to meet existing MIL specifications.

These components are available in 7 and 9-pin sockets and in four different versions: Type A for general-purpose applications where extra rigidity and resistance to vibration and shock are not important factors; Type AX for special applications requiring extra rigidity; Type B, same as A, but with tube shield added; and Type BX, same as AX, but with tube shield added.

Complete details are available by writing Ad. Auriema, Inc., 89 Broad Street, New York 4, N.Y., U.S.A.

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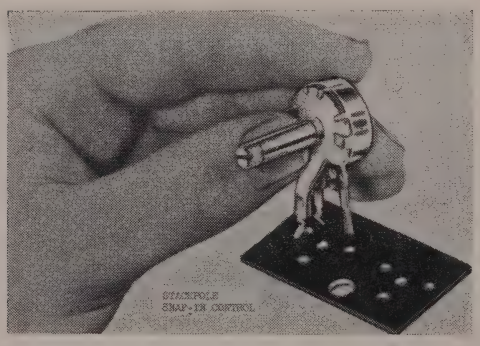
NEW SNAP-IN CONTROLS TAKE LESS SPACE IN PRINTED CIRCUITS



A self-supporting, snap-in variable resistor for printed wiring has recently been announced by the Electric Component Division of Stackpole Carbon Company. This control, known as the Stackpole Type LR-70, measures only 57/64 in. diameter and stands 7/8 in. off the mounting board. It is supported by four legs—the three regular voltage taps, and a larger, case ground leg. No mounting hardware is required since the legs merely snap into the printed wiring board to form a strong support. Terminals are heavily tin-lead coated for fastest soldering with dip solder techniques.

These variable composition resistors find wide applications in TV, FM, AM receivers, auto radios, and other printed circuits chassis where space and cost must be held to a minimum. Gold-plated ring-spring and contact hub-spring contactors assure smooth, quiet operation. Cases are nickel plated.

The shaft is firmly supported by a 3/32 in. extruded bushing, and may be left round or equipped with flat, screwdriver slot, split knurl, diamond or straight knurl, or tongue. Single or double-pole snap switches are available with ratings from 15 amps, 15 volts DC; to 6 amps, at 125 volts AC-DC.

The LR-70 is rated at .75 watts for values above 10,000 ohms, and .50 watts below 10,000 ohms.

Specifications and dimensions are available from Stackpole Carbon Company, Export Division, 89 Broad St., New York 4, New York.

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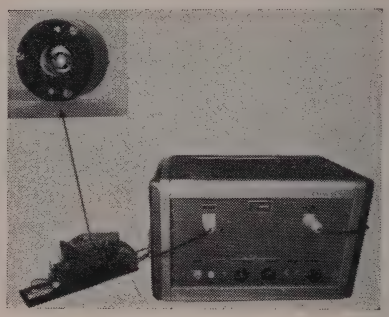
NEW HIGH-SPEED LIGHT PULSING AND MODULATION APPARATUS



Light pulses in the microsecond range and modulated light beams at variable frequencies from D.C. through the video region are easily obtained with the new model high speed light pulsing and modulation apparatus announced by Baird Associates-Atomic Instrument Company, 33 University Road, Cambridge 38, Mass. Applications for this equipment to date include use in such areas as sound-on-film, video-on-film, polarimetry, densitometry, photography, photometry, interferometry, measurement of semiconductor parameters, psychological experiments and biological studies.

The light modulator, a crystalline analogue of a Kerr cell, is made up of a Z cut (001) plate of ammonium (ADP) or potassium (KDP) di-hydrogen phosphate. The crystal plate is placed between electrodes which will allow light to pass in the same direction as the applied electric field. For normally incident collimated light, the unit has the properties of a polarization retardation plate, with magnitude of retardation directly proportional to the applied voltage. When the crystal device is placed between polarizers, a light beam can be intensity-modulated in accordance with the voltage applied to frequencies well beyond the video region.

Five models of the light modulator are available to meet a wide range of operating requirements.

When used with a high voltage pulser, the light modulator "floats" between the plates of two 5C22 thyratron tubes. Initially, this system is at the same potential as the power supply which has charged the high voltage plate condensers. At the beginning of the pulse, one of the 5C22 thyratrons is fired, bringing one electrode of the light modulator to ground potential. The pulse is terminated with the firing of the second thyratron, which brings the other end of the crystal to ground potential. Both thyratrons then extinguish, and the charging process begins again.

Two models of high speed pulsers are available, both of which incorporate a variable high voltage power supply and a trigger rate generator which is set to approximately 20 cps. Two units differ principally in output pulse lengths and rise and decay times. Type JK produces pulses having a rise and decay time of approximately 0.2 microsecond and continuously variable widths from 50-1000 microseconds. Type JS produces pulses having a rise and decay time of approximately 0.1 microsecond and a length of 2 microseconds. Both require approximately 200 watts at 115 volts, 60 cycles.

Pulse amplitudes are continuously variable from 2–5 kv. Special models with different pulse widths or repetition rates can be built on request. For signals of arbitrary shape, special modulating amplifiers can be supplied for audio or video bandwidths. Tuned amplifiers requiring very little power are adequate for fixed or variable single sine wave light intensity modulation.

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The Editor's Opinion

THREE "CLIPPER" CAR RADIOS

Latest commercial radio equipment to be sent to us for test is a batch of three "Clipper" car sets. These have been put through their paces in the "R. & E." Morris Minor, and the story of their design and performance is presented below.

INTRODUCTION

Car radios are common enough objects today, but the Editor like many of his readers, is old enough to remember a time when they were not only distinct rarities, but also unreliable, difficult to install, and exceedingly bulky. Added to which, vibrator hash and ignition interference were very difficult to eliminate, with the result that the final installation may have been something to be proud of, but its performance certainly left something to be desired.

These days, however, the story is somewhat different, and these three sets, built by Akrad Radio Corporation, and marketed by Messrs G. A. Wooller & Co. Ltd., represent typical present-day standards of construction, ease of installation, and performance.

THREE MODELS

The "Clipper" range comprises three sets, between them covering a range of prices to suit most tastes in this important matter, each giving excellent performance in its own class. The smallest is a five-valve job of extremely compact form, in which the whole "works", including the vibrator power supply, is housed in a cabinet no larger than holds the tuning head and I.F. amplifier in the eight-valve models. The other two models each have eight valves, one with push-buttons, and the other without. In other respects these two sets are very similar. All three sets have separate speaker housings, in the case of the "five" this holds only the speaker unit, but in the other two it also houses the power supply, and the last three valves in the receiver unit. All three models are complete in the two units, and a feature that will appeal to all potential users is their compactness, which is even more marked in the case of the eight-valve models than in the five, since their sizes are virtually identical.

CONSTRUCTION

One of the designer's most difficult problems in relation to a car radio is that of mechanical rigidity, for any set that is carried in a vehicle (even a well sprung one) is subject to shock and vibration. Such apparently elementary matters as inducing valves to stay in their sockets become of major importance, as do the supporting of components in such a fashion that vibration will not cause the leads, which have to fulfill the double function of connection and support, to break off. In these important respects, these "Clipper" models gain full marks. Ample use is made of insulated tag-strips, and these are so placed that no component is supported on more than the minimum possible length of lead. Under these circumstances, the leads are amply strong enough to support their respective parts, and a careful examination failed to show a single place where mechanical failure looks likely to occur. The valves used in the tuning heads of the larger sets are miniatures, each with its own spring-loaded shield, which in itself is enough to prevent both coupling to other parts of the circuit, through stray capacity, and mechanical failure through vibration. This is not all, however. The valves have been so positioned that the end of each shield closely approaches the end-plate of the unit. In the end-plate are holes, one opposite each valve; soft rubber bungs are fitted into the holes so that they bear firmly on the ends of the valve shields. In so doing, they effectively "firm up" the valve mounting without putting undesirable pressure on the ends of the valves themselves.

Anyone examining the inside of these sets for the first time might be forgiven for remarking that precious few precautions appear to have been taken against vibrator hash, but the appearance is entirely deceptive. A very simple, but effective, method is used for filtering the incoming and outgoing leads from the sets. In the eight-valve models, for example, there are two additional speaker sockets, so that extension speakers may be used. These, and the six-pin socket that goes between the two units, are mounted on a cadmium-plated steel plate which acts also as one plate of a pair of low-inductance bypass condensers. The other two plates of these condensers are mounted to this base-plate with insulated rivets, and insulated from it by a piece of thin card, which forms the dielectric of the two condensers. The "hot" battery lead comes through a grommeted hole in the case, straight to one of these condensers, then via an R.F. "A" choke to the other condenser, whence it goes out through the multi-core cable to the R.F. head, where the on/off switch is situated. Since the cable is shielded, the A lead does not pick up ignition interference on the way. A further "A" choke in the return lead, which brings the battery voltage back from the switch to the A.F. and vibrator unit, effectively prevents this lead from delivering hash voltages to the tuner. These precautions are entirely successful. On trial in the car, it was found that even with the gain control fully advanced, and the aerial disconnected, vibrator hash was completely absent, as was ignition noise from the engine, even when the bonnet was up. We have mentioned this at some length because of its extreme importance in a car radio. Another point of interest is the use of non-synchronous vibrators, and valve rectifiers in these sets. It used to be thought that the current saved by the use of synchronous, or self-rectifying vibrators was very important, but today, with the advent of low-drain valves for car sets, the additional reliability of the non-synch. variety is much more worth-while, in this writer's opinion at least.

We cannot leave the technical features of the sets without an "honourable mention" for the push-button permeability-tuned R.F. head in the P.B. 8-valve model. This is an excellently engineered piece of work, which is very easy for the user to re-set, even while the car is travelling along. There is absolutely

no need for the buttons to remain set to one's own local stations when the car is a long way from home, and the setting mechanism is positive in action, and very accurate in its tuning, once set. We specially liked the clutch mechanism which allows the buttons to drive the pointer of the dial without having to turn the manual tuning knob.

PERFORMANCE

Having written thus far, we find that space is running out, and no mention has been made of the excellent performance of these sets. In the first place, they were installed (not all together, of course) with a minimum of time and trouble, and from the first performed admirably, without any trouble from ignition interference. We still do not know whether our car is suppressed or not, but the fact is that it was not even necessary to find out! The first set to go in was the "five", and its performance astonished us. The aerial used was a 6ft. whip mounted on the off front wing, and on this, even in the middle of Wellington, excellent reception was obtained from such stations as 3YA, 3ZB, 2ZA, and even 2YN in Nelson. At night, the "Aussies" came rolling in. This gives some idea of the sensitivity of this little set—so great in fact that we wondered whether the eights were really necessary. The five has plenty of power output to overcome wind and road noises, and we were loath to remove it from its very temporary installation. Needless to say, the eight-valve models do give improved performance, as is only to be expected. The way they will hold fading signals, and the reserve power output, not to mention their quieter performance on distant stations are all advantages to be obtained for the extra purchase-money.

All in all, we were very much impressed with this trio of sets, and are sure that no one will be disappointed in any one of them.

BRITISH PLASTICS FEDERATION'S WORLD-WIDE SERVICE

Steps are being taken to make better known overseas the unique service offered by the British Plastics Federation in publishing each month abstracts from technical articles in journals throughout the world dealing wholly or partly with plastics developments. The service includes the publishing of patents from the countries which have an important plastics industry.

The abstracts service costs £10 10s. a year (post free). Abstracts are available in bound or unbound versions, the latter being printed on one side only. Photostat or microfilm copies of most articles can also be obtained from the Federation, whose offices are 47-48 Piccadilly, London, W.1., England.

So far, abstracts go to 26 overseas countries, Australia, U.S.A., and Russia being the largest three buyers. Others taking the abstracts in quantity include Germany, Holland, France, Czechoslovakia, China, South Africa and the Scandinavian countries.

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SNAPS FROM THE N.Z. RADIO & TELEVISION MANUFACTURERS' FEDERATION CONFERENCE AT TAUPO, OCTOBER, 1956

Above: The conference adjourned for a short time to examine one of the Post & Telegraph Department's latest radio interference measuring vehicles. These are equipped for a wide variety of radio measurements, including the absolute field strengths of signals over a wide frequency range.

Left: Snapped on the steps of the conference hall during a break in the proceedings. Messrs Brown, Spencer, and Gobbie, with (seated) Messrs G. Cosgrave (Secretary), and Meighan.

Top: General view of the conference room during an apparently absorbing discussion.

Above: The new President, Mr Trevor Gobbie, of Dominion Radio & Electrical Corporation, discusses a knotty point with Messrs H. Brown, Loudspeakers (N.Z.) Ltd., and W. Meighan, Sheffield Radio Corporation.

NEW SOLID ELECTROLYTE BATTERY WITH UNLIMITED SHELF LIFE DEVELOPED BY NATIONAL CARBON

PARMA, OHIO, August 28.

A new solid electrolyte battery with practically unlimited "shelf life" has been developed by National Carbon Company, a Division of Union Carbine and Carbon Corporation. Designed for low-current applications, the battery weighs less than an ounce, and is made primarily of silver, silver iodide, and vanadium pentoxide.

Extensive laboratory tests have indicated that the solid electrolyte battery should give up to several decades' continuous service in suitable applications, such as maintaining a charge on capacitors in electronic circuits, according to Dr. Clarence E. Larson, National Carbon Company's vice-president in charge of research.

Only one-third of an inch in diameter and one inch long, the battery weighs but one-fourth of an ounce, and consists of 200 paper-thin cells. It is rated at 95 volts. A continuous current drain of ten micro-microamperes can be maintained, with flash currents in the microampere range.

Has Theoretical Infinite Shelf Life

In service the battery can withstand temperatures ranging from —70° to +170° F., with no appreciable change in voltage. It is a true solid state battery, and is not dependent upon liquids, gases, or vapours for its operation, nor does it form them under any service condition. Its completely "dry" construction gives it theoretical infinite life when not in use, and regardless of how long it is stored on a shelf, it will always be "fresh" when placed in active use.

Currently in pilot plant production, the solid electrolyte battery represents three years of intensive research by National Carbon scientists in the fields of physical chemistry, solid state physics, electrochemistry, inorganic chemistry,and metallurgy. Further development work is being continued here at the new multi-million research laboratories at Parma, Ohio, which will be dedicated on September 18.

Commercially available in the near future, the new battery will undoubtedly find use in equipment such as radiation detection devices and possible military applications.

This arresting new concept in battery design adds still further to the lengthy list of the National Carbon Company's basic contribution to the dry battery industry. Earlier achievements included, of course, the very first commercial production of dry batteries and the miniaturization of portable dry batteries through the development of the "Mini-Max" wafer type cell as used extensively today in hearing aids and portable radio equipment. —P.B.A.

CHRISTMAS MESSAGES

(Continued from page 20)

bers, and to see the genuine striving on the part of all present towards greater unity in the radio trade. It was pleasurable also to see our Association embark on a campaign to stimulate greater interest in the bona fide radio and electrical dealer.

At the time this Message is published, advertising throughout the whole Auckland Province will solicit the purchaser of radio and electrical equipment to take advantage of the knowledge and experience of his radio expert, and we are convinced the public will benefit from the inter-change of ideas and the code of ethics practised by the legitimate trader.

Christmas is a time when we look towards our fellow man hoping that we can help in some way to improve his lot, and we of this Association feel that the unity we have achieved through our Association's activities is indicative of the benefits that can be made by uniting for a common cause. What a wonderful thing it would be if Nations could achieve, in a much bigger way, that esprit de corps which is evident in the radio trade today.

These are sad days, from the point of view of world peace, but our members are convinced that the co-operation between Nations towards a common goal can achieve a lasting peace, just as we are well on our way to achieve the goal of a better radio industry through out discussions and interchange of opinion and ideas.

It is with this thought that we can say a Happy and a thoughtful Christmas to all. May all who read this Message find satisfaction in their endeavours towards better goodwill.

The significance of His Birthday should inspire us all.

W. J. MURPHY,
President.

BINDERS FOR "R. & E."

These are available to hold 12 issues—price 6s. 6d.

Financial Trends

(Continued from page 43)

remaining after payment of the preference dividend represented 23.38 per cent. on ordinary capital. The company's reserves total £283,280, £8,280 more than combined ordinary and preference share capital.

Cory-Wright & Salmon Ltd. reported a £2,100 fall in net profit to £19,515. Preference dividend of 5 per cent. on £100,000 took £5,000; and ordinary dividend, reduced from 7½ to 6 per cent., took £12,000. Profit remaining after payment of the preference dividend represented 7.3 per cent. on ordinary capital of £200,000. The company has reserves of £34,603.

Among capital equipment which the company has on order for New Zealand are "English Electric" turbines for Atiamuri, large transformers for State hydro works, and three "English Electric" turbo generators for Mercer.

This brief review deals only with companies whose shares are commonly traded on the Stock Exchange. Several smaller companies have had difficulties, in some cases sufficiently serious to bring about liquidation.

Some remarks made by the chairman of Cory-Wright & Salmon, Mr C. W. Salmon, could be used to sum up. "We do not subscribe to any pessimistic view of New Zealand's future," he said. "We are confident about the long-term outlook. However, the Government's policy to combat inflation has brought about a changing pattern, which affects many trading businesses. Not to budget for and not to have a policy to meet this change of pattern must be wrong."

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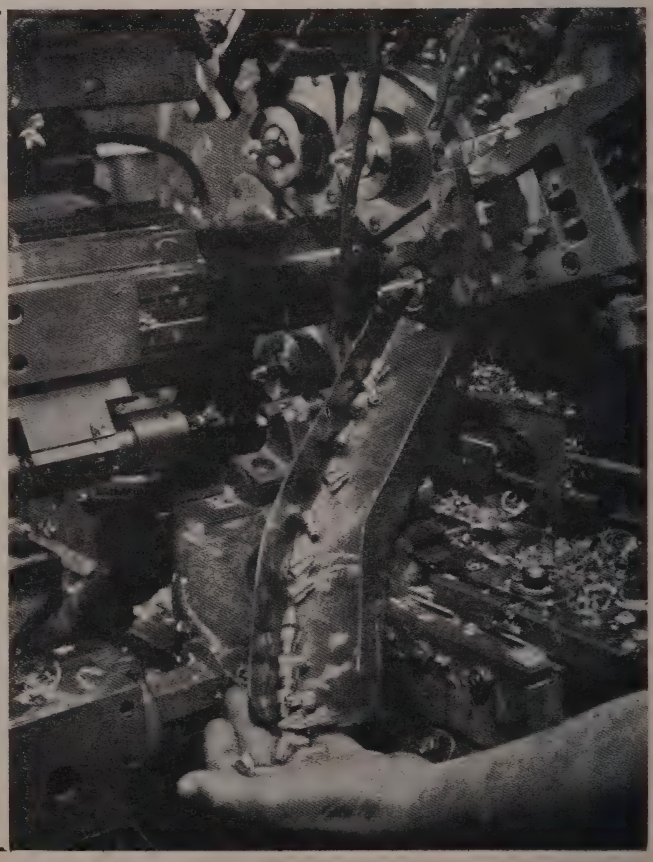

Synchrodyne

(Continued from page 25)

However, this can be carried only so far, because there is a limit to the allowable H.T. voltage on the triode sections of the ECH81s.

It will be found, when setting up this receiver, that, as with all synchrodyne circuits, there is a limit also to the greatest signal that can be handled by the R.F. amplifier before this tube introduces distortion into the output. Increasing the signal input does help to secure a tighter oscillator lock, but care must be taken that distortion in the R.F. amplifier does not arise. It has been found that the locking is such that the heterodyne obtained on tuning through a station does not disappear until it has reached quite a low frequency—about 100 c/sec. or so. This is what indicates a loose lock, because the tighter the locking the higher the frequency at which the heterodyne disappears.

In general, no attempt should be made with this circuit to produce a tighter lock than this. The first step in adusting the circuit is to set the balancing potentiometer, according to the procedure described earlier. It is essential that the oscillator be functioning when this is done, because, although an excellent balance can be obtained with the oscillator stopped, the balance point will be found to change considerably when it is re-started.

First of all, a station should be tuned in approximately by finding the amount of fixed capacity needed in order to bring the station within tuning range of the Philips trimmer. With this capacity installed in the oscillator circuit, the aerial tuning condenser can now be adusted. First of all, set the trimmer so that a strong heterodyne is obtained, making no attempt to bring the oscillator into lock. Then adjust the aerial tuning until the heterodyne is loudest, thus indicating the strongest input signal. While this is being done, the appropriate series condenser in the aerial circuit should be set at about half capacity, and not touched, while the tuning is being adjusted. Next, de-tune the oscillator further, until the heterodyne can no longer be heard. Turn up the gain control on the audio amplifier being used, and a weak version of the modulation of the signal will be heard. Then adjust the balancing potentiometer until this is a minimum. After this has been done, there is no need to touch the balance control further, and the rest of the job is solely concerned with tuning the oscillator and aerial circuits correctly on each switch position, and in setting the series condensers in the aerial circuit so that all stations have about the same A.F. output level.

Only good-quality silvered mica condensers should be used as the fixed components in the oscillator circuit, and the required capacity for each station should be made up using as few of them in parallel as possible. After the fixed capacities have been chosen and installed, final setting up should be done by setting the panel trimmer to half capacity, and then tuning in all stations accurately with their respective trimmers. When this is done, the tuner can be put into normal use, with the panel trimmer as the sole adjustment.

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36 Range dynamometer instrument
SUBSTANDARD ACCURACY TO B.S. 89.
Measures A.C. current voltage and power

0-500 volts	0-25 amps	0-12,500 watts
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UP go the sales

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PROMINENTLY IN YOUR *WINDOW*
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every kitchen!
every cooking requirement!

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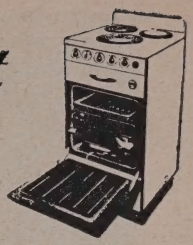

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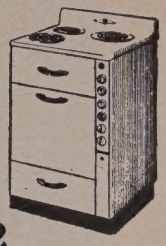
Medium price range, popular choice.



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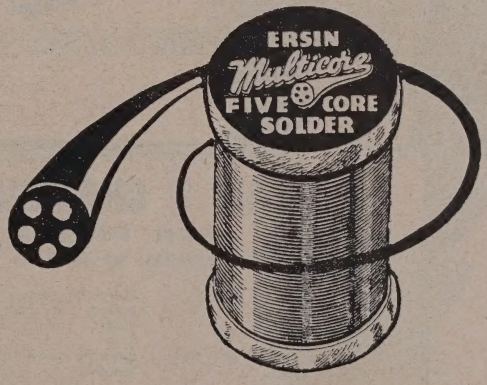

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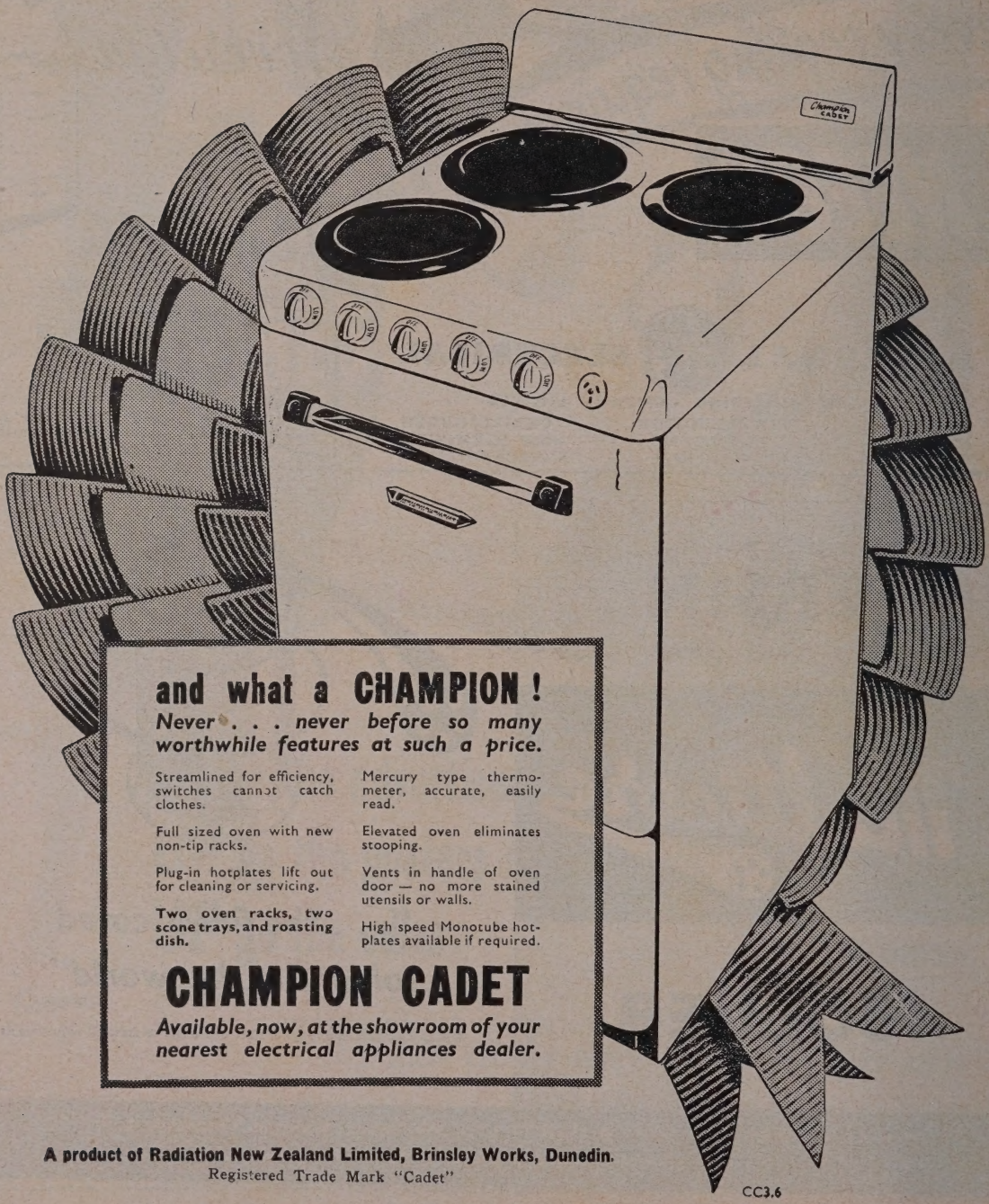

and what a CHAMPION!

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Streamlined for efficiency, switches cannot catch clothes.

Mercury type thermometer, accurate, easily read.

Full sized oven with new non-tip racks.

Elevated oven eliminates stooping.

Plug-in hotplates lift out for cleaning or servicing.

Vents in handle of oven door — no more stained utensils or walls.

Two oven racks, two scone trays, and roasting dish.

High speed Monotube hotplates available if required.

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Available, now, at the showroom of your nearest electrical appliances dealer.

A product of Radiation New Zealand Limited, Brinsley Works, Dunedin.
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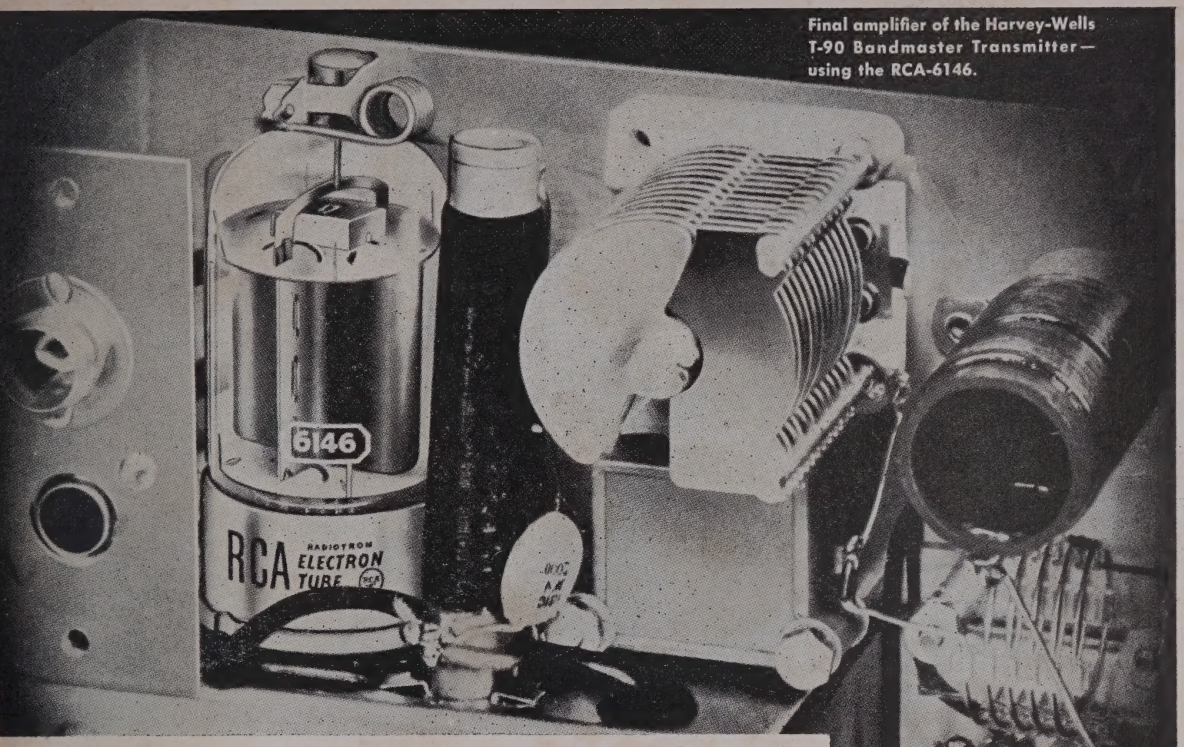

Final amplifier of the Harvey-Wells T-90 Bandmaster Transmitter—using the RCA-6146.

Leading Amateur Designs

...USE RCA TUBES

You are looking at the business end of a Harvey-Wells T-90 Transmitter. In this "final" an RCA-6146 beam power tube delivers the signal punch that gives this transmitter its reputation for ability to "get out."

Here's why RCA high-perveance beam power tubes, like the 6146, are preferred by leading designers of amateur and commercial transmitters.

RCA beam power tubes make it practical to use fewer components, fewer tuning controls—*fewer stages*. They lend themselves to bandswitching circuits—take full plate input with smaller drivers (a big help in reducing TVI). RCA beam power tubes give you the power you want *at lower plate voltages*.

RCA High-Perveance Beam Power Tubes are available at your RCA Tube Distributor—for amateur transmitters having input-power ratings up to a "gallon." For technical data on any specific beam power tube type including the 6146, write

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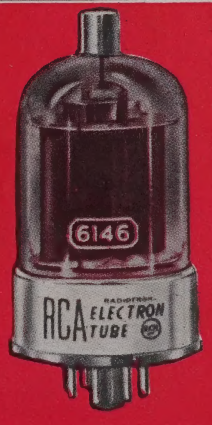

BEAM POWER TUBE RCA-6146

90 watts ICAS input on CW; 67.5 watts on 'phone. Full input to 60 Mc. Reduced input up to 175 Mc.

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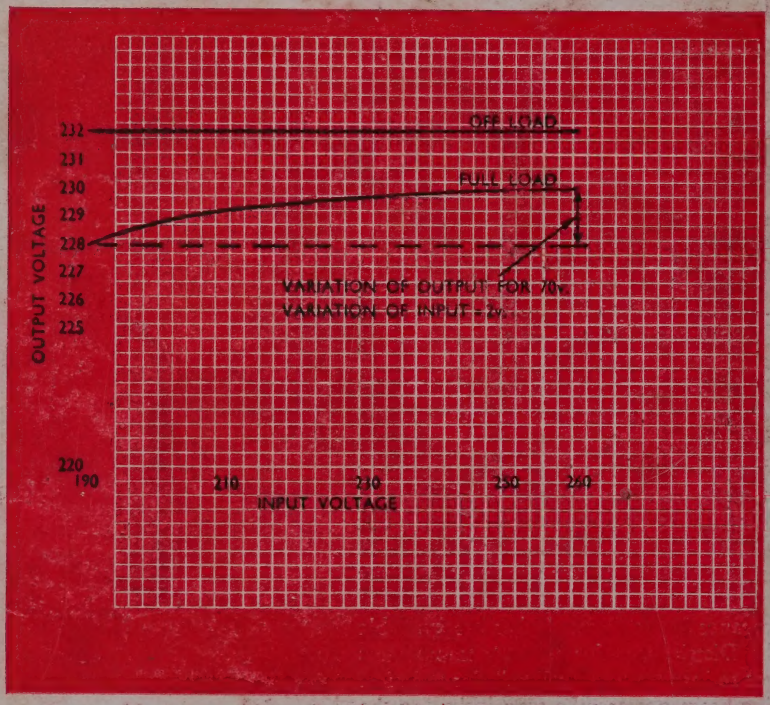
CONSTANT VOLTAGE TRANSFORMERS

Electrical equipment, whatever its function, cannot provide its optimum performance unless it is supplied with the specific voltage for which it was designed. This fact has long been recognised, but is today receiving even greater attention because of the new and more critical demands made by modern science, particularly in the field of electronics. Ordinary mains variations can have a very serious effect on the performance of laboratory instruments, on the testing and calibration of meters, X-ray and photographic apparatus, and many other industrial processes.

For many years "Advance" have specialized in the design of Constant Voltage Transformers for use with a wide variety of equipment where a stabilized voltage supply is demanded. Developments made in this field have resulted in making available not only a full range of stabilizers, but special types with a low harmonic content, and also particular automatic and adjustable voltage stabilizing devices for specific applications.

REGULATION.

The output voltage is substantially independent of load variation, but if good stability is required under varying load conditions, these conditions should be specified in order that a suitable model may be offered.



OUTPUT VOLTAGE

The stabilisers are normally set to within ± 1% of nominal voltage, and are adjusted to give a constant R.M.S. voltage. They can be specially designed to give a constant peak or average voltage.

150, 250, and 500 watt models are available ex stock.

Any capacity up to 6 kilowatt can be quoted for against indent.

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